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JOURNAL OF PALEONTOLOGY

JOSEPH A. CUSHMAN, Editor

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DECEMBER 1929

SOME OSTRACODES FROM THE HARAGAN MARL, DEVONIAN, OF OKLAHOMA

ROBERT ROTH
Bartlesville, Oklahoma

ABSTRACT

The origin and history of the term Haragan is fully described, and three of its most fossiliferous localities have been collected from, including the famous "White Mound". The ostracodal content is herein described. This fauna is compared with the New Scotland of the Appalachian region, and as far as the literature permits with the Silurian and Devonian of foreign countries.

The following genera are represented by new species or varieties: *Aparchites*, one variety; *Bollia*, one new species; *Aechmina*, two new species; *Paraechmina*, one new species; *Beyrichia*, one new species; *Dizygopleura*, three new species; *Amphissites*, two new species; *Octonaria*, one new species; *Thlipsura*, seven new species; *Craterellina*, one new species; *Bythocypris*, two new species; *Pontocypris*, one new variety; *Cytherella*, one new species.

The following new genera are also instituted: *Phanassymetria* with two new species; *Janusella* with one new species; *Condracypris* with two new species.

A rather complete bibliography on Silurian and Devonian ostracodes also accompanies the paper.

ACKNOWLEDGEMENTS

The author wishes to express his appreciation to Dr. R. S. Bassler for the use of several type forms of ostracodes, from the collection at

the National Museum at Washington, D. C., for generic comparisons. For reading the manuscript and checking the validity of new genera and species, the author wishes to thank Dr. E. O. Ulrich, Dr. R. S. Bassler, and Dr. R. C. Moore.

Introduction and Purpose

The name Haragan was given by Dr. Reeds to an unnamed creek in the Ardmore quadrangle in sec. 17, T. 2 S., R. 3 E., and from this he derived the name of the formation. Three to four miles southeast of Dougherty there are excellent exposures of the formation along the creek mentioned and this region was taken as the type area. "White Mound" may be found in this region.

The early authors called this formation a shale. However, from a study of well cuttings and the outcrops it is thought that the term "shale" should be dropped as the material is a very fine-grained granular calcareous marl, and is not a shale in any of its aspects. Lithologically the Haragan greatly resembles the underlying Henryhouse and in the absence of fossils it is very doubtful whether the two could be distinguished. Dr. Reeds made a very careful faunal study of the Haragan marl and concluded that its age was New Scotland, and since the underlying Henryhouse is Niagaran, the unconformable contact between the two is also the line between the Silurian and Devonian.[1]

The Haragan marl where it outcrops varies in thickness from a few feet to approximately a hundred feet. It together with the underlying Henryhouse marl weathers out more rapidly than the overlying Bois d' Arc limestone and the underlying Chimneyhill limestone. As a result gullies are frequently formed between the two more resistent limestone beds and many good exposures are thus obtained. Besides being exposed in the Arbuckle Mountains, the Haragan marl has been identified in well cuttings from the Seminole region and also in the well cuttings from the north side of the Wichita Mountains where it is buried to considerable depth by the overlying Permian redbeds of the Clear Fork-Wichita group.

Several years ago a large number of samples were collected from the Haragan marl and, in due course of time, these samples were washed and their ostracodal content studied. The ostracodes found in this marl proved to be of great variety and of exceptional interest. Some are very peculiar and are extremely bizarre in outline, and all but one or two are not listed in any of the literature on Silurian-De-

[1] Reeds, Chester A., American Journal of Science, vol. 32, October, 1911.

vonian ostracodes. Several of the more characteristic forms were sent to Dr. Bassler and after examining them he concurred with the idea that the Haragan bears resemblances to the New Scotland in New York.[2] This comparison was made from the collection at the National Museum at Washington, D. C.

The literature upon the Silurian-Devonian formations is very abundant and quite accessible. Because of the widespread character of the Hunton terrain of which the Haragan marl forms the basal portion of the upper half, it was thought that these ostracodes should be described. In photographing these forms it has been found advisable to vary the source of the light because if it remained in a uniform position in respects to the ostracode certain depressions could not be observed. As a result the author has departed from the prescribed method as used by the Smithsonian Institute.

From a careful study of the literature there seems to be no homotaxial equivalent to the Haragan marl;—that is as far as the published literature is concerned. The material described from the Devonian by the Maryland Geological Survey contains but one form which is identical with that of the Haragan marl. The great abundance of the Thlipsuridae would seem to show a close relationship to the Silurian, but again, there is no exact correlation between species. Undoubtedly, however, better correlations will be found in the future when more complete work has been done on the New Scotland and adjacent formations.

Origin of the Name of Haragan

In going through the available literature, the author was unable to find where the term "Haragan" came from. As a result it is believed advisable to set forth the information which he has obtained relative to this name.

Taff first described the Hunton formation in Professional Paper No. 31 of the U. S. Geol. Survey, which was reprinted as Bulletin No. 12 of the Oklahoma Geological Survey.

Dr. Chester A. Reeds, after being graduated from the University of Oklahoma in 1906, obtained a position with Dr. Schuchert who had just come to Yale. In this position Dr. Reeds worked for all or part of two or three summers in the Arbuckle Mountains. As a result of part of this work Dr. Reeds wrote Bulletin No. 3 of the Oklahoma Geological Survey entitled "A Report on the Geological and Mineral

[2] Personal communication.

Resources of the Arbuckle Mountains, Oklahoma". This was published in 1910.

In Taff's report the Hunton was divided into three general divisions: limestone at the top and bottom with marls between. On paleontological grounds it was recognized that the base of the Hunton was Silurian, and the top, Devonian. In Dr. Reeds' report, Bulletin No. 3, Oklahoma Geological Survey, he does not subdivide the Hunton, but says, "The lists of fossils in Prof. Paper No. 31 together with the large supplementary collection of the writer show that there should be a different arrangement of the beds according to their faunal characteristics. As defined by Taff, the Hunton embraces rocks of Silurian and Devonian age. This formation will be treated fully in a forthcoming paper." Dr. Reeds' Doctor's thesis at Yale under the direction of Dr. Schuchert was entitled "The Hunton Formation of Oklahoma", and an abstract of this thesis was published in the American Journal of Science, Vol. 32, October, 1911, pages 256-268 inclusive. It is in this paper that the four divisions of the Hunton since recognized as Chimneyhill, Henryhouse, Haragan, and Bois d' Arc were introduced. On pages 263 and 264 Dr. Reeds says, "Excellent exposures containing abundant fossils are to be seen in the "White Mound" region along Haragan creek three to four miles southeast of Dougherty. This is the type area. The formation takes its name from Haragan creek which flows westward across the strike of the formation about one-fourth of a mile north of "White Mound". The term Haragan, which is used here as the formation name, has been applied to an unnamed creek which may be seen on the Ardmore quadrangle in sec. 17, T. 2 S., R. 3 E. The Henryhouse and Haragan shales are both exposed here and when taken together constitute Taff's middle member."

In looking at a map of the Ardmore quadrangle Haragan Creek is located two to three miles southeast of Dougherty. The north branch rises in section 8 about two miles straight east of the town and flows south, joining the east branch near the SW corner of sec. 17, thence flowing diagonally southwest across sec. 19, and joining another creek near the railroad just before entering the Washita River. Haragan Creek has long been known to the natives as Board Creek from the fact that many of the early settlers used to make clapboards and shingles from the oak trees which grew on this creek. One of the early settlers, who lived in a log house near the south side of sec. 17 was known as "Old Man" Haragan. This old house is still standing and is about a quarter of a mile north of "White Mound". Dr. Reeds

put up with this family when he was working in that region, and hence named the formation and the creek from the Haragan farm.

The gist of the above statements are taken from a personal communication from Dr. Charles N. Gould of the Oklahoma Geological Survey. The following statements are taken from a personal communication from Dr. Chester A. Reeds of the American Museum of Natural History.

At the time when Dr. Reeds worked in the area, place names which had not already been used in geological publications were not very numerous in the Arbuckle Mountains. As a result he found it necessary to give the name "Haragan" to the creek that flows westward by the "White Mound". The name "Board Creek", which Dr. Gould refers to above, appears to have been unknown to Dr. Reeds when he subdivided the Hunton formation. The four formation names were approved by the Committee on Geologic Names of the U. S. Geol. Survey before Dr. Reeds published his paper in 1911. Since the term Haragan has been approved by the U. S. Geol. Survey, and the name Board Creek has not appeared on any of the government publications it seems fitting that the term Haragan be retained.

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DESCRIPTION OF SPECIES

Phylum ARTHROPODA (articulates)

Class CRUSTACEA

Subclass EUCRUSTACEA Kingsley (CRUSTACEA proper)

Superorder OSTRACODA Latreille

Family APARCHITIDAE Ulrich and Bassler

Genus APARCHITES Jones

APARCHITES VARIOLATUS, var. HUNTONENSIS, n. var.

Plate 35, figs. 1 *a*, *b*

General outline of carapace circular to ovate. Maximum length is midway between the dorsal and ventral margins. Maximum height is approximately midway between the anterior and posterior extrem-

ities. Maximum breadth is through the central portion of the carapace. In some forms there is a faint swing, which when found is arbitrarily chosen to be backward. Vavular overlap is practically wanting. There is, however, a very faint rabbetting around the free margin and across the hinge line which would indicate some overlap. In some forms the dorsal margin is faintly convex; while in others it is very convex. The hinge line is straight and very elementary. The ventral margin is rather uniformly convex. The anterior and posterior extremities are uniformly curved until they join the dorsal and ventral margins. Surface ornaments are very simple. There are no false keels or nodes. The reticulations are very large and deep; in general, they are polygonal in outline and are best developed in the central portion of each valve. There is an area of each valve adjacent to the dorsal margin and the free margin in which all reticulations are wanting. Also in the central portion of each valve there is a small area containing no reticulations. This barren spot is rather variable in size as well as in occurrence, and probably indicates a poorly developed pit. There seems to be no true pit.

Dimensions.—Maximum length, 0.91 mm.; maximum height, 0.75 mm.; maximum width, 0.51 mm.

Species relationships.—This form appears to be quite closely related to *A. variolatus* in that it is ovate and coarsely reticulate. The variety herein described is nearly twice as large as *A. variolatus.* When these interesting forms are compared with the genotype, *A. whiteavesi* Jones, it is believed that there can be little doubt that the two forms are not related generically. When the form herein described is referred to the genus *Aparchites* it should be understood that it is questionable. This questionable generic relationship was first noted by Ulrich and Bassler when they established the species *A. variolatus.*

Holotype.—U. S. N. M. No. 80654.

Horizon and Locality.—Upper Haragan marl, sec. 4, T. 2 N., R. 6 E., Pontotoc Co., Okla. Middle Haragan marl, SW/NE sec. 28, T. 3 N., R. 6 E., Pontotoc Co., Okla.

Superfamily BEYRICHIIDAE Jones

Family PRIMITIIDAE Ulrich and Bassler

Genus BOLLIA Jones and Holl

BOLLIA HARAGANENSIS, n. sp.

Plate 35, figs. 2 *a-d*

General outline of carapace subquadrate with a very faint posterior swing which in many cases is wanting. Maximum length is midway between the dorsal and ventral margins. Maximum height is about one-third of the distance from the anterior to the posterior extremity. Maximum width is between the anterior portion of the marginal ridge. The faint backward swing together with the bulbous termination of the U-shaped second ridge indicates the posterior moiety. Valvular overlaps were not observed excepting in the deformed species. Dorsal margin is straight throughout its entire length. The anterior cardinal angle is very slightly less than the posterior cardinal angle. Both are considerably greater than 90 degrees. No interlocking teeth were to be found on the hinge line. Ventral margin is very gently convex for about one-half the maximum length and is sometimes slightly sinnuate. Anterior extremity boldly curves from the ventral margin to the hinge line. Posterior extremity has a greater curvature than the anterior extremity, thus also indicating the posterior portion of the carapace. The surface ornaments consist of two ridges. The first ridge parallels the free margin very closely. The posterior portion of this ridge is quite tumid and rises abruptly from the free margin. Along the ventral margin this ridge is quite depressed, while in the anterior extremity it again rises to considerable prominence, although it is much thinner and is set back from the free margin about one-sixth of the distance from the anterior to the posterior extremity. This marginal ridge terminates anteriorly and posteriorly on the hinge line. Inside of this ridge and separated from it by a marked depression is the second and smaller and irregular ridge. This second ridge also rises from the hinge line and the upper anterior half is quite depressed. Posteriorly it rises from the line of maximum length toward the hinge line where it becomes extremely bulbous and terminates as such just before reaching the hinge line. This ridge encloses quite a deep sulcus which has a somewhat backward swing. There appear to be no other ornaments on the carapace.

Dimensions.—Maximum length, 1.45 mm.; maximum height, 0.81 mm.; maximum width, 0.68 mm.

Species relationships.—This species is very closely related to *B. irregularis* Ulrich and Bassler. However, the form herein described is considerably larger and has quite a space separating the anterior portion of the first ridge and the anterior extremity. Furthermore, the first ridge appears to be very much more depressed along the ventral margin than is the case in *B. irregularis.* In other respects they seem to agree quite closely.

Holotype.—U. S. N. M. No. 80651.

Horizon and Locality.—Basal portion of Haragan. "White Mound", NE/c sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

Genus AECHMINA Jones and Holl

AECHMINA INEQUALIS, n. sp.

Plate 35, figs. 3 *a-c*

General outline of carapace subovate. Maximum length is midway between the dorsal and ventral margins. Maximum height is midway between the anterior and posterior extremities and lies about in the plane of maximum length. The anterior end may be determined from the fact that the right valve is larger than the left, and that the horn faces toward the anterior. Valvular overlap is quite pronounced, but as the complete carapace studied is somewhat deformed the overlap may be accentuated. The free margin of the right valve overlaps the left, and does so most prominently along the ventral margin. Dorsal margin is straight. Anterior cardinal angle is very gently curved from the dorsal margin to the anterior extremity. Posterior cardinal angle is considerably more angulate. The termination of the hinge line gives the dorsal margin a length considerably in excess of half the maximum length. Hingement is not discernible; at least no means of articulation could be observed. Ventral margin is quite convex and this convexity is rather uniform, being more accentuated anteriorly and posteriorly. Anterior extremity is rather sharply curved. The posterior extremity is considerably blunter, which causes the posterior cardinal angle to be sharper than the anterior one. Surface ornamentation consists simply of a rather peculiar dorsal spine which points upward and toward the anterior. Its anterior aspect is considerably more like a horn as it appears quite elevated from this side. To the posterior the horn gently slopes down to the carapace in a shoulder which has its inception just above the pos-

terior cardinal angle. In the end view of the complete carapace the left valve shows a transverse ridge running parallel to the hinge line and below the horn. It is believed that this is due to the deformation of the carapace. No other ornaments were observed.

Dimensions.—Maximum length, 1.22 mm.; maximum height, 0.81 mm.; maximum width, 0.77 mm.

Species relationships.—This form is very unique principally in the peculiar development of the spine and the fact that it is inequivalved, which characters may cause it to be placed in a separate genus. However, the material studied is not perfect enough for such determination. There are no forms described which resemble this species.

Holotype.—U. S. N. M. No. 80647.

Horizon and Locality.—Basal Haragan marl, "White Mound", NE/c sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

AECHMINA GENEAE, n. sp.

Plate 35, fig. 4 *a*

General outline of carapace subrectangular. Maximum length is approximately midway between the dorsal and ventral margins, being somewhat nearer the latter. Maximum height is midway between the anterior and posterior extremities, being somewhat nearer the

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EXPLANATION OF PLATE 35

FIGS. 1 *a, b.*—*Aparchites variolatus*, var. *huntonensis*, n. var. *a*, Left valve, ×30; *b*, another left valve, more ovate and showing the spot resembling a pit, ×30.

2 *a–d.*—*Bollia haraganensis*, n. sp. *a*, Right valve, × 20; *b*, a different right valve, ×20; *c*, ventral aspect, ×20; *d*, dorsal aspect, ×20.

3 *a–c.*—*Aechmina inequalis*, n. sp. *a*, Right valve, ×20; *b*, anterior extremity, ×20; *c*, left valve, ×20.

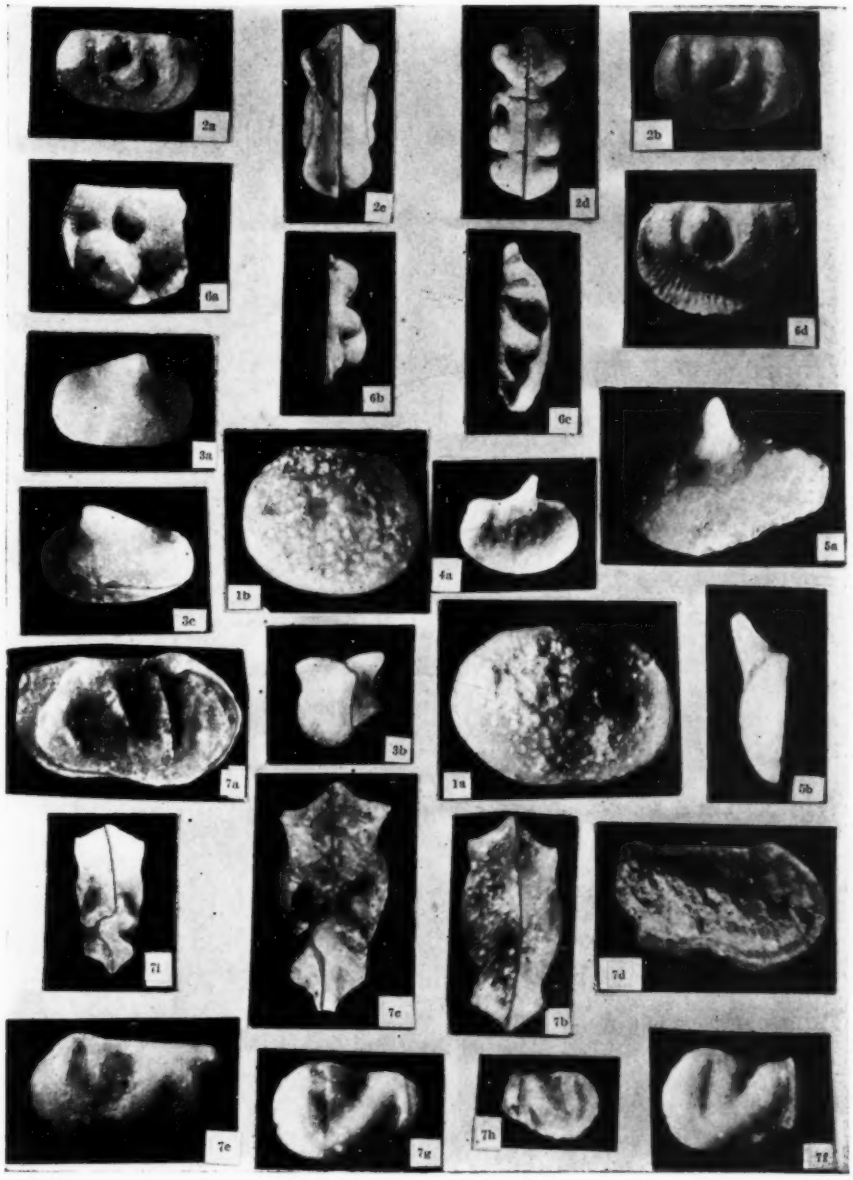
4 *a.*—*Aechmina geneae*, n. sp. Right valve, ×20.

5 *a, b.*—*Paraechmina ambigua*, n. sp. *a*, Right valve, ×30; *b*, posterior extremity, ×30.

6 *a–d.*—*Beyrichia fittsi*, n. sp. *a*, Right valve of female, ×20; *b*, dorsal view of female valve, ×20; *c*, dorsal view of male valve, ×20; *d*, right valve of male, ×20.

7 *a–i.*—*Dizygopleura landesi*, n. sp. *a*, Left valve, ×30; *b*, ventral aspect, ×30; *c*, dorsal aspect, ×30; *d*, interior of right valve, ×30; *e*, immature right valve, ×30; *f*, immature right valve, ×30; *g*, very young right valve, ×30; *h*, very young left valve, ×30; *i*, dorsal aspect mature form, ×20.

All dorsal and ventral aspects are so orientated that the anterior extremity is pointing toward the top of the plate.


2a
2c
2d
2b
6a
6b
6c
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3a
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7g
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posterior. Maximum width is in the posterior quarter, being well down upon the valves. The orientation of the valves is indicated by the horn pointing toward the anterior, and by the maximum width which is situated in the posterior portion of the carapace. Valvular overlap is not discernible. However, a complete carapace without some deformity has not been found, and as a result this point cannot be definitely settled. Dorsal margin is straight throughout its entire length, which is more than half the maximum length. The anterior cardinal angle is very obtuse; while the posterior cardinal angle is much more angulate. This results in a sharp break between the dorsal margin and the posterior extremity. Hingement is not well defined as there seem to be no vestiges of articulation preserved. Ventral margin is broadly convex, curving more in the anterior quarter where it joins the anterior extremity; while in the posterior quarter its junction with the posterior extremity is more or less angulate. Anterior extremity is broadly curved from the dorsal to the ventral margin. The posterior extremity is much blunter and the curvature joining the dorsal and ventral margins is more angulate. Surface ornamentation consists of a single, very prominent dorsal spine situated upon each valve. This spine tends to point outward and away from the dorsal margin. It assumes a considerable length in perfect specimens. Around the free margins there is a very faint row of papillae. These papillae are very minute and are much more pronounced along the posterior extremity. No other ornaments were noted.

Dimensions.—Maximum length, 1.00 mm.; maximum height, 0.81 mm.

Species relationships.—This species is quite closely related to *A. bovina* Jones, in that the row of papillae on the free margin is the same and the horn is also more or less the same in its position and character. *A. geneae* differs from this form in that its horn is smaller and the outline of the carapace is more rectangular. It is also larger. Another species which is quite similar to the form herein described is *A. bovina* Jones, var. *punctata* Krause. The var. *punctata,* however, is much smaller; its carapace is punctate; the marginal row of papillae is more pronounced; its horn in relation to the rest of the carapace is much larger.

Holotype.—U. S. N. M. No. 80648.

Horizon and Locality.—Basal Haragan marl. "White Mound", NE/c sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

Genus PARAECHMINA Ulrich and Bassler

PARAECHMINA AMBIGUA, n. sp.
Plate 35, figs. 5 *a, b*

General outline of carapace subovate to subquadrate. Maximum length is slightly nearer the ventral than the dorsal margin. Maximum height is slightly in the posterior quarter. Maximum breadth is also in the posterior quarter. The orientation can readily be noted as the pit is below the horn and situated posteriorly to it. The horn points to the anterior and the maximum height and breadth are in the posterior. No valvular overlap could be discerned as only one broken valve representative of this genus has been found. Dorsal margin is straight and occupies about one-half of the maximum length. The anterior cardinal angle is formed by the gentle confluence of the dorsal margin and the anterior extremity. Posterior cardinal angle is much more angulate, although it is still an obtuse angle. Hingement was not discernible. Ventral margin is very convex, especially toward the anterior. Anterior extremity is broadly curved. Posterior extremity is much blunter thus giving rise to the more pronounced posterior cardinal angle. Surface ornamentation consists of a rather short horn situated near the hinge line which points slightly toward the anterior and away from the carapace. This horn when compared with the rest of the valve is quite small. Just below and to the posterior of this horn there is a rather large pit, which is well shown in the photograph. No other ornaments were noted upon the carapace.

Dimensions.—Maximum length, 1.08 mm.; maximum height, 0.81 mm.; maximum width, 0.48 mm.

Species relationships.—There may be some question as to whether this form is a *Paraechmina* or not. The only point which would class it in *Paraechmina* is the pit as *Aechmina* is supposed to have neither a pit nor a marginal flange or ridge. There are some forms described which are somewhat similar, notably *P. postica* Ulrich and Bassler. However, the spine in *P. postica* is much larger and there seems to be more of a depression separating this spine from the rest of the carapace. *P. intermedia* Ulrich and Bassler also bears a resemblance to the form described here. However, it has a faint marginal ridge which will sufficiently differentiate it from *P. ambigua.*

Holotype.—U. S. N. M. No. 80649.

Horizon and Locality.—Basal Haragan marl. "White Mound", NE/c sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

Family BEYRICHIIDAE Jones (restricted Ulrich and Bassler)

Genus BEYRICHIA McCoy

BEYRICHIA FITTSI, n. sp.

Plate 35, figs. 6 *a-d*

General outline of carapace subrectangular. Maximum length is midway between the dorsal and ventral margin. Maximum width in the male is in the anterior quarter. In the female it is measured through the brood pouch situated in the posterior ventral portion. The orientation of this form is very simple. The brood pouch in the female valve at once indicates the posterior, and the backward swing in the male valve will readily serve for its orientation. Valvular overlap is not pronounced, in fact, none can be discerned due to the fact that only single valves were found. However, it seems from a study of the free margin of the right valve that there is a faint groove or rabbetting which may or may not indicate valvular overlap. Dorsal margin is straight throughout, and when viewed from the inside it is but a trifle shorter than the maximum length. The fringe, however, adds sufficiently so that the maximum length may be measured further down on the valve. In the form studied there is no dentition or method of articulation, hence the hingement is simple. The anterior cardinal angle is a little more obtuse than the posterior cardinal angle. Ventral margin is convex. Anterior extremity is rather acutely angled as it curves sharply into the dorsal margin. Posterior extremity is broadly curved up to the dorsal margin, which character gives the carapace a pronounced backward swing. Surface ornaments are very characteristic. The carapace has a pronounced false keel on each valve. This keel where it joins onto the main carapace is scalloped into radiating striations which extend out halfway across, and in some cases even three-quarters of the way across, the false keel or fringe. This keel is almost always broken in some part or other. However, it seems to develop in the anterior ventral quarter, thence posteriorly rises until it is most prominent in the posterior ventral quarter. It is then gradually depressed and fades before meeting the hinge line at the posterior cardinal angle. The female valve does not have the flange or frill nearly as well developed as it is in the male. The valves are roughly trilobate with a faint hint in the male valve of being quadrilobate, as the broadest and anterior lobe is faintly divided into two lobes as it approaches the hinge line. This large anterior lobe is very prominent and has a very pronounced backward swing in both the male and female forms. It is broadest in the plane of maximum

length. It then pinches down until just below the second lobe it is but a shelf. From this point on this shelf develops into the third major lobe, which is rather faint and extends up to the hinge line. The second lobe or node is very pronounced, and is subovate in character. It rises from the hinge line and is depressed again about in the plane of maximum length. This node is completely surrounded by a rather deep depression excepting where it joins the hinge line. About all three of these major lobes there is a continuous depression which separates this part of the carapace from the frill or false keel. This character is very noticeable in the male valve only. The carapace is covered with very faint, roughly polygonal reticulations. However, in the male valve the surface seems to be covered more with fine papillae rather than a system of meshwork.

Dimensions.—Maximum length, 1.40 mm.; maximum height, 1.00 mm.; maximum width, 0.45 mm.

Generic and species relationships.—This form is very closely related to *B. veronica* Ulrich and Bassler. However, *B. veronica* is quite prominently punctate, which character does not show in the form described herein. The frill or false keel on the form described apparently is much larger; the anterior or first lobe is faintly divided into two lobes and attains far greater prominence than the third lobe. The third lobe in *B. veronica* appears to be quite well developed, and also the space between the second lobe and the frill is marked by a depression; while the form *B. fittsi* has a shelf connecting the first and third lobes. Other forms which somewhat resemble the one described and which may be found in European journals are *B. steusloffi* Krause and *B. maccoyiana* Jones. There are several forms in American publications which bear similar relationships and are well discussed by Ulrich and Bassler in the Silurian volume of the Maryland Geological Survey.

Holotype.—U. S. N. M. No. 80655.

Horizon and Locality.—Middle Haragan marl, SW/NE sec. 28, T. 3 N., R. 6 E., Pontotoc Co., Okla.

Family KLOEDENELLIDAE Ulrich and Bassler

Genus DIZYGOPLEURA Ulrich and Bassler

DIZYGOPLEURA LANDESI, n. sp.

Plate 35, figs. 7 *a-i*

General outline of carapace subquadrate with a pronounced backward swing. Maximum length is approximately midway between the

dorsal and ventral margins. Maximum height is three-fourths of the distance from the anterior to the posterior extremity. Maximum breadth is in the line of maximum length and about one-quarter of the distance from the anterior to the posterior extremity. The posterior quarter may readily be distinguished as it contains the longest sulcus. The medium and anterior sulci have a backward swing. The interlocking tooth and socket on the hinge line are situated on the posterior cardinal angle and the maximum height is also found in the posterior quarter. There is considerable variation in the overlap between young and old specimens. The right valve has a marked tendency to overlap the left along the ventral and posterior margins and on the anterior cardinal angle. On the posterior cardinal angle the right valve has a very pronounced tooth which fits into a depression on the left valve. Dorsal margin is more or less straight, excepting for a protuberance on the anterior cardinal angle and the interlocking tooth on the posterior cardinal angle. (See fig. 7 *a*.) The hinge line itself is straight. Ventral margin is irregularly inclined to the hinge line. The left valve is decidedly concave, and the right valve much less so along this margin. This character gives prominence to two apparent humps on the ventral margin of the right valve. (See fig. 7 *d*.) The anterior extremity is slightly convex and meets the dorsal margin at an acute angle in the more immature forms. Usually, however, it is slightly greater than 90 degrees. There is very little overlap at this extremity. Posterior extremity curves convexly from the ventral to the dorsal margin. The surface ornaments consist of ridges and sulci. In the anterior quarter there is a highly variable but pronounced shoulder starting from the hinge line. This shoulder runs out and over the carapace meeting the line of maximum length at its maximum point forward. From this point it curves to the posterior and fades into the free margin at about one-quarter of the distance from the anterior to the posterior extremity. Just posterior to the shoulder there is a marked sulcus extending upward from the ventral margin and fading out before reaching the hinge line. It is quite deep just above the ventral margin and has a faint posterior swing. A second shoulder which is quite pronounced separates this sulcus from the sulcus extending downward from the hinge line. The second sulcus is very pronounced and is roughly triangular in shape with its apex pointing just a little to the posterior. A faint ridge extends downward from the hinge line and meets the prominent ridge separating the first and second sulci. Just posterior to this ridge is another long sulcus run-

ning more or less at right angles to the hinge line, extending downward from the overlapping tooth, and having a very faint curvature to the anterior. Just before reaching the ventral it dies out about in the place of maximum height. The last ridge rises abruptly from the posterior extremity in many forms.

Dimensions.—Maximum length, 1.16 mm.; maximum height, 0.64 mm.; maximum width, 0.54 mm.

Holotype.—U. S. N. M. No. 80645.

Horizon and Locality.—Middle Haragan marl, SW/NE sec. 28, T. 3 N., R. 6 E., Pontotoc Co., Okla. Upper Haragan marl, sec. 4, T. 2 N., R. 6 E., Pontotoc Co., Okla.

Generic and species relationships.—In studying this interesting form the author believes that the wide range of variation found indicates successive stages or molts. With this in mind it has been noted that at any particular stage or size a uniformity will be found; that is, the smallest forms are all similar to each other and the largest forms are also similar to each other. When the largest and smallest forms are compared they show differences great enough to make a new species, but these differences diminish as successive stages are studied.

In discussing generic relationships, the author has used the Silurian volume of the Maryland Geological Survey quite freely. Quoting from it we have the following generic description:

"Genus *Dizygopleura* Ulrich and Bassler. Surface of valves usually quadrilobate, rarely trilobate, the lobes separated by three, rarely two, long sulci, of which the anterior may be in part or entirely obsolete.

"Genotype.—*Dizygopleura swartzi* Ulrich and Bassler. The many species of this prolific genus may be divided into five groups for purposes of comparison. The five groups are listed below and will be followed by a brief comparison of the species herein described.

"1. Group of *Dizygopleura proutyi* Ulrich and Bassler. Anterior sulcus confined to the ventral half, anterior lobe more or less bulbous.

"2. Group of *Dizygopleura intermedia* Ulrich and Bassler. Anterior side of lobed area defined, but anterior sulcus wanting. The pair of anterior lobes confluent.

"3. Group of *Dizygopleura subdivisa* Ulrich and Bassler. Like two, but anterior sulcus developed in anterior median part of raised lobed area.

"4. Group of *Dizygopleura swartzi* Ulrich and Bassler. Distinctly quadrilobate, lobes thick, anterior and posterior sulci long, narrow, deeply impressed, the middle sulcus shorter.

"5. Group of *Dizygopleura heiroglyphica* Krause. Valves depressed, convex, lobes narrower than the furrows."

From a comparison of these five groups it will at once be noted that *D. landesi* falls into the fourth group. Under this group there is a large number of species which are as a whole quite similar to *D. landesi.* However, the character and position of the anterior sulcus makes this species rather distinctive. Furthermore, the absence of a horn projecting above the anterior cardinal angle also serves to distinguish this form. In all respects it seems to be very closely related to *D. swartzi. D. minima* Ulrich and Bassler bears a striking resemblance to some of the very small forms which were photographed for this paper, and as has been stated it is believed that this form is probably one of the earlier molts of the more matured forms.

The author is pleased to name this form after Dean Henry Landes of the University of Washington, Seattle.

DIZYGOPLEURA RECTA, n. sp.

Plate 36, figs. 8 *a-c*

General outline of carapace subrectangular. Dorsal aspect subrectangular. Anterior aspect subovate. Maximum length is midway between the dorsal and ventral margins. Maximum height is in the anterior quarter. Maximum width is between the central portion of the posterior ridge surrounding the anterior crater. The anterior end is the one containing the most perfect crater, and by this it may readily be distinguished from the posterior end. The right valve overlaps the left. This overlap is most noticeable along the ventral margin. The overlap continues around the anterior and posterior extremities. Along the dorsal part of the posterior extremity the overlap is quite pronounced. The right valve shows a decided rabbetting along all margins into which the left valve fits. There is practically no overlap along the hinge line. Dorsal margin is straight and where it joins the anterior extremity it forms an obtuse angle. Posteriorly the dorsal margin slopes into the posterior extremity at a very large angle. Hingement is very primitive, there being nothing more than a groove and socket arrangement. The hinge line occupies approximately one-half of the maximum length. The ventral margin is more or less straight. However, it is slightly concave in its central portion. This is very noticeable in the right valve. The ventral margin is approximately as long as the maximum length. The anterior extremity is rather stubby. Its maximum curvature is in the anterior ventral portion. The posterior extremity slopes more from the hinge line to the ventral margin as it is somewhat depressed in the dorsal

posterior portion. Its greatest curvature is also in the ventral posterior extremity. Surface ornaments consist of two oval-shaped craters. One across the anterior quarter extends from the anterior dorsal angle downward across the carapace, and slightly points forward until it is just above the ventral margin at its junction with the anterior extremity. This crater is decidedly elongate and its maximum width lies a little below the maximum length of the carapace. The lip of this crater rises at right angles above the carapace excepting on the ventral portion. The dorsal portion extends slightly above the hinge line. The posterior half of the crater is curved more than the anterior half. Just posterior to this crater there is in some forms a broad central node subcircular in outline. The other or posterior crater is not as well developed as the anterior one. In fact the anterior portion of the lip surrounding this crater is almost obsolete. The second crater is not as long as the anterior crater and is inclined a little more to the rear. The anterior half of the lip surrounding this crater does not rise as steeply above the carapace as the lip surrounding the anterior crater. This depression is also elongated and is almost at right angles to the hinge line. There are no other ornaments upon this form.

Dimensions.—Maximum length, 1.59 mm.; maximum height, 1.00 mm.; maximum width, 0.86 mm.

Generic relationships.—The author has seen nothing in the literature to which this form may in any way be referred, excepting very faintly in certain respects. *Phreatura concinna* Jones and Kirkby is a form which has an anterior and posterior crater or semicircular pit. It is found in the Carboniferous of Yoredale in England. Further than that there is no resemblance as *Phreatura concinna* is strongly compressed in the posterior portion of the shell, the carapace is subreniform in outline, and it has no distinct hinge line. *Craterellina* Ulrich and Bassler has a single crater in the anterior portion of the carapace; it has no hinge line; the carapace is subreniform in outline. These characters show no relationship to *Dizygopleura recta*, *Dizygopleura recta* probably shows a more close relationship to *Dizygopleura loculata* Ulrich and Bassler. This form has an anterior and posterior crater-like depression separated by a sulcus. The lips of the anterior crater are very broad; while the posterior crater has practically no lip shutting it off from the dorsal margin. Both forms are faintly quadrilobate. The general outline of the carapace of *D. loculata* is the same as that of *D. recta*, although this form has many points of difference. Dr. Ulrich and Dr. Bassler agree in placing *D.*

recta in the genus *Dizygopleura*. Under this classification *D. recta* will fall into the third group.

Genotype.—U. S. N. M. No. 80669.

Horizon and Locality.—Basal Haragan marl, "White Mound", sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

DIZYGOPLEURA OBLIQUA, n. sp.
Plate 36, figs. 9 *a, b*

Dizygopleura obliqua is similar to *D. recta* in all respects except the following: Its anterior crater is broader and inclined, pointing from the anterior cardinal angle toward the junction between the ventral margin and the anterior extremity. The posterior half of the lip surrounding this crater is very depressed. There is no central node. The posterior crater is also inclined, but in the opposite direction to the anterior crater. The depressed lips of both craters give the form a more rectangular outline when viewed from the dorsal or ventral aspects. *D. recta* when viewed in the same way shows the lips of the craters to stand out very prominently. The maximum length of *D. obliqua* is slightly greater in relation to the carapace than the maximum length is to the carapace of *D. recta*.

Dimensions.—Maximum length, 1.72 mm.; maximum height, 0.90 mm.; maximum width, 0.81 mm.

Holotype.—U. S. N. M. No. 80668.

Horizon and Locality.—Basal Haragan marl, "White Mound", NE sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

Family KIRKBYIDAE Ulrich and Bassler

Genus KIRKBYA Jones

Subgenus AMPHISSITES Girty

AMPHISSITES PRIMAEVUS, n. sp.
Plate 36, fig. 10 *a*

General outline of carapace subquadrate. Maximum length is midway between the dorsal and ventral margins. Maximum height is about midway between the anterior and posterior extremities. Maximum width is in the anterior dorsal portion. The anterior end may be identified as that end which contains the most prominent dorsal shoulder. Valvular overlap is very indistinct due to poor fossilization. However, along the ventral margin the left valve faintly overlaps the

right. The manner of articulation which is usually so prominent in forms found in the Carboniferous seems to be almost obsolete in this case. Dorsal margin is roughly concave due to the prominence of the anterior and posterior shoulders which rise above the cardinal angles. Hingement is practically wanting. However, the hinge line itself is straight and the two cardinal angles are quite obtuse and are of about the same degree of angularity. The ventral margin is rather uniformly convex. The anterior extremity is quite bluntly curved. This curvature is sharper where it joins the dorsal and ventral margins. The posterior extremity is almost identical with the anterior extremity, excepting on the posterior dorsal portion where there is somewhat more of a slope and less angularity between the dorsal margin and the posterior extremity. Surface ornaments are quite simple. The false keels are wanting, but their position is marked by parallel rows of reticulations. These rows of reticulations roughly parallel the free margin and are somewhat concentric about the pit. The anterior and posterior nodes are quite prominent and rise well above the hinge line, there being a very marked depression between the two. The carapace is tumid around the ventral portion of the pit. The reticulations are coarse and are roughly polygonal in outline. The central portion of each reticulation is quite deep. The pit is very pronounced and is located in the central portion of the carapace. On the dorsal side of the pit there is a groove which runs toward the hinge line for a short distance. This groove gives the pit somewhat the appearance of a sulcus.

Dimensions.—Maximum length, 0.73 mm.; maximum height, 0.45 mm.

Generic and species relationships.—This form undoubtedly falls into the subgenus *Amphissites*. Due to the state of fossilization there are certain details which could not be definitely ascertained. None of the species from the Carboniferous are very closely related to this form. As a result little difficulty may be experienced in identification.

In a previous paper by the author *Amphissites*[3] was made a subgenus under *Kirkbya*. At that time little work had been done on these forms previous to the Carboniferous, and as a result the relative evolution of the two groups had not been studied. *Kirkbya* having been described first no reason was then apparent for making it a subgenus. Subsequently, it seems that *Kirkbya* probably evolved from *Amphissites* at some period in the early Carboniferous or late Devonian, and from the standpoint of antiquity *Amphissites* really

[3] "A Revision of the Ostracod Genus Kirkbya and Subgenus Amphissites", Wagner Free Institute of Science, vol. 1, 1929.

seems to be the parent form, although in its present status it occupies a lesser position than *Kirkbya*.

Holotype.—U. S. N. M. No. 80658.

Horizon and Locality.—Upper Haragan marl, sec. 4, T. 2 N., R. 6 E., Pontotoc Co., Okla.

AMPHISSITES RETIFERUS, n. sp.

Plate 36, fig. 11 *a*

General outline of carapace subovate with a rather pronounced backward swing. Maximum length is midway between the dorsal and ventral margins. Maximum height is about two-thirds the distance from the anterior to the posterior extremity. The maximum breadth is in the plane of maximum height and lies a little above the plane of maximum length. The anterior end may be defined as the sharpest end, the backward swing being away from the anterior extremity. The posterior cardinal shoulder will also help to define the two ends. Valvular overlap could not be definitely ascertained as only a single valve of this interesting form was found. From a careful study of this valve it seems that any overlap would be very elementary. Dorsal margin when viewed from the side appears to be inclined toward the anterior. This is due to the rather pronounced shoulder developed in the posterior quarter. Hingement is interesting

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EXPLANATION OF PLATE 36

FIGS. 8 *a–c*.—*Dizygopleura recta*, n. sp. *a*, Left valve, ×20; *b*, dorsal aspect, ×20; *c*, anterior extremity, ×20.

9 *a, b*.—*Dizygopleura obliqua*, n. sp. *a*, Right valve, ×20; *b*, ventral aspect, ×20.

10 *a*.—*Amphissites primaevus*, n. sp. Left valve, ×30.

11 *a*.—*Amphissites retiferus*, n. sp. Right valve, ×30.

12 *a, b*.—*Octonaria punctata*, n. sp. *a*, Left valve, ×30; *b*, another left valve, ×30; *c*, right valve, ×30; *d*, well preserved right valve, ×30; *e*, posterior extremity, ×30; *f*, ventral view, ×30.

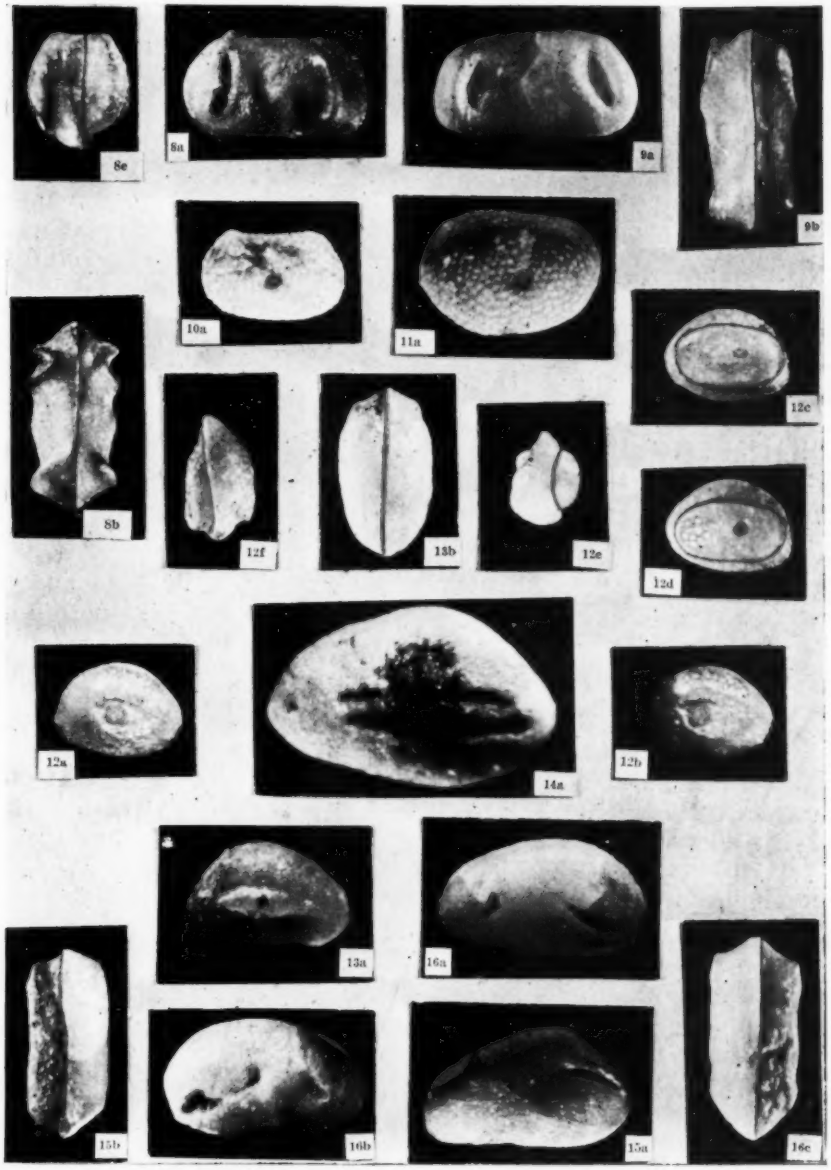
13 *a, b*.—*Thlipsura striatopunctata*, n. sp. *a*, Left valve, ×30; *b*, dorsal aspect, ×30.

14 *a*.—*Thlipsura parallela*, n. sp. Right valve, ×30.

15 *a, b*.—*Thlipsura curvistriata*, n. sp. *a*, right valve, ×20; *b*, dorsal aspect, ×20.

16 *a–c*.—*Thlipsura fossata*, n. sp. *a*, Right valve, ×20; *b*, left valve, ×20; *c*, dorsal aspect somewhat deformed, ×20.

All dorsal and ventral aspects are so orientated that the anterior extremity is pointing toward the top of the plate.


8c
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16c

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as it shows a strong similarity to *Kirkbya* and is very characteristic of the subgenus *Amphissites*. The hingeline is straight, and attains to about one-half the maximum length. It is grooved throughout very faintly and at the anterior and posterior cardinal angles this groove is slightly enlarged. This character would lead one to believe that the left valve has a very faint enlargement just under the cardinal angles which will fit into these corresponding grooves. The anterior and posterior cardinal angles are approximately the same, if anything, the anterior angle is the more obtuse. The posterior shoulder is depressed inward to the hinge line. The ventral margin is irregularly convex, excepting for a small portion immediately under the pit which is slightly concave. The anterior extremity is uniformly curved from the dorsal to the ventral margin. The posterior extremity is very broadly curved. When viewed from either side it will be noted that the carapace extends outward and beyond the free margin and above the hinge line. This character is pronounced along the ventral margin and in the area of the dorsal shoulder. There are no false keels, but along the ventral margin of each valve there is a rather broad band separating the part protruding beyond the free margin and the free margin itself. This band has a faint ridge paralleling the free margin, which character may indicate the amount of overlap of the right valve by the left. There are no nodes, excepting the shoulder which is above the posterior cardinal angle. This shoulder is not of great importance. Reticulations are polygonal in outline, coarse, and roughly concentric about the area just posterior to the pit. These reticulations decrease in size toward the margins and are completely wanting in the band mentioned above. The pit is depressed, circular, and well defined. In the photograph the material above the pit is some of the adhering matrix and does not mark a sulcus.

Dimensions.—Maximum length, 0.91 mm.; maximum height, 0.62 mm.

Generic and species relationships.—This form is very closely related to *Primitia? concentrica* Ulrich and Bassler, differing, however, in the anterior extremity which is more pointed in the form herein described. Its main distinguishing features separating it from *Primita* are a reticulated surface, an *Amphissites* hingement, and its centrally situated pit. In these respects the form is somewhat similar to *P. valida* Jones and Holl from the Silurian of the Island of Gotland. *A. retiferus* shows some points which may be found in the genus *Laccoprimitia* Ulrich and Bassler; that is, a border along the free edge or margin, and the centrally situated pit. The nodes or swellings are not

very prominent on the form herein described. When *A. retiferus* is compared with some of the Primitias there is little room for doubt that the form does not fall under the genus *Primitia*.

From a study of the plate in the Silurian volume of the Maryland Geological Survey the author believes that *Primitia? concentrica* Ulrich and Bassler really belongs under the subgenus *Amphissites*. This point, however, cannot be proven until a study has been made of the original.

Holotype.—U. S. N. M. No. 80659.

Horizon and Locality.—Upper Haragan marl, sec. 4, T. 2 N., R. 6 E., Pontotoc Co., Okla. Lower Haragan marl, "White Mound", sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

Superfamily CYPRIDACEA Zenker

Family THLIPSURIDAE Jones

Genus OCTONARIA Jones

OCTONARIA PUNCTATA, n. sp.

Plate 36, figs. 12 *a-f*

General outline of carapace subovate. Maximum length is midway between the dorsal and ventral margins. Maximum height is midway between the anterior and posterior extremities. Maximum width is in the posterior quarter. Anterior extremity may be distinguished by its compressed character and by the lack of ornaments. The left valve widely overlaps the right on all extremities, the greatest overlap being in the dorsal portion and to a lesser extent along the ventral margin. As opposed to the irregular form of the left valve, the right valve is almost a perfect ellipse. Dorsal margin is arcuate and compressed longitudinally. Hingement is imperfect, the left valve having the groove along the dorsal and free margins to receive the right valve. Ventral margin is almost straight, being slightly convex. Anterior extremity is tapered; while the posterior extremity is more broadly curved and angulate. Surface ornaments consist of a small pit in the central part of the right valve. Posterior to this pit there is a depression which contains about a dozen large reticulations. This depression is bordered on the anterior dorsal portion by a ridge. The left valve has a hexagonal meshwork of reticulations in an arcuate depression just under the compressed portion of the dorsal margin. Below this depression there is an elevated ovate

flange or ridge surrounding a depressed area. In the anterior portion of the depressed area there is a small node; while the posterior portion is ornamented with a series of hexagonal depressions to form a meshwork. In some forms there is a faint indication of a pit below the enclosed node. There are no other ornaments upon the carapace.

Dimensions.—Maximum length, 0.64 mm.; maximum height, 0.45 mm.; maximum width, 0.35 mm.

Species relationships.—This form resembles *Octonaria inaequalis* Ulrich and Bassler. The difference is that the form herein described has reticulations, a pit, and does not have the system of grooves which are shown in *O. inaequalis.*

Holotype.—U. S. N. M. No. 80653.

Horizon and Locality.—Upper Haragan marl, sec. 4, T. 2 N., R. 6 E., Pontotoc Co., Okla. Middle Haragan marl, SW/NE sec. 28, T. 3 N., R. 6 E., Pontotoc Co., Okla.

OCTONARIA INAEQUALIS Ulrich and Bassler

A single left valve of this species was found in the middle Haragan. The valve is in a perfect state of preservation and there is no doubt about its identity. No photograph is shown.

Locality.—Middle Haragan marl, SW/NE sec. 28, T. 3 N., R. 6 E., Pontotoc Co., Okla.

Genus THLIPSURA Jones and Holl

THLIPSURA STRIATOPUNCTATA, n. sp.

Plate 36, figs. 13 *a, b*

General outline of carapace subreniform. Dorsal aspect ovate. Maximum length is much closer to the ventral than to the dorsal margin. Maximum height is in the anterior half. Maximum width is approximately in the center of the carapace. The anterior extremity is the blunter, thus making it easily definable. The right valve overlaps the left, but not very markedly. Dorsal margin is acutely convex and extends slightly forward. There is no specialized hingement. Ventral margin is straight, excepting in the posterior half where it is slightly concave. Anterior extremity is blunt and extends somewhat in an inclined plane from the ventral margin backward toward the dorsal margin. Posterior extremity is gently curved. Surface ornaments consist of two more or less parallel furrows extending across fully two-thirds of the anterior portion of the valve. These furrows fade as they progress toward the posterior. Their anterior termination is abrupt as they are stopped by a faint ridge or angulation in

the carapace, which angulation or ridge more or less parallels the inclined anterior extremity. This ridge fades both toward the dorsal and ventral margins. In one form a minute horn, pointing toward the anterior, was noted extending from the ventral termination of this ridge. The interior surface of the two parallel furrows are ornamented with coarse punctations. There were no other ornaments noted.

Dimensions.—Maximum length, 0.84 mm.; maximum height 0.51 mm.; maximum width, 0.48 mm.

Generic and species relationships.—*T. striatopunctata* has the same specific relationships that *T. parallela* shows to the rest of the Thlipsuridae. Its small size and anterior ridge serve to distinguish it.

Holotype.—U. S. N. M. No. 80656.

Horizon and Locality.—Middle portion Haragan marl, SW/NE, sec. 28, T. 3 N., R. 6 E., Pontotoc Co., Okla.

THLIPSURA PARALLELA, n. sp.

Plate 36, fig. 14 *a*

General outline of carapace subreniform. Dorsal aspect subovate. Maximum length is midway between the dorsal and ventral margins. Maximum height is slightly anterior to the center of the carapace. Maximum width is approximately in the center of the carapace. The two parallel striations extend almost to the anterior extremity. This is chosen to indicate the orientation. The right valve overlaps the left prominently, excepting in the center of the dorsal margin and the posterior ventral margin. Dorsal margin is very convex. There is no specialized hinge line. Ventral margin is slightly sinnuate and is concave in the posterior ventral portion. Anterior extremity is bluntly curved. Surface ornaments consist of two parallel striations or furrows, running across the central portion of the valve. They develop at a point about three-quarters of the distance from the anterior to the posterior extremity, and then extend forward. The lower furrow extends farther than the upper one; both terminate abruptly in a slight bulge just above the central portion of the anterior extremity. These furrows have several large pits in them which are more or less irregular.

Dimensions.—Maximum length, 1.48 mm.; maximum height, 0.91 mm.; maximum width, 0.45 mm.

Generic and species relationships.—*T. parallela* is closely related to *T. striatopunctata.* The difference is in the greater extent of the parallel furrows, the large size, and the absence of the anterior

ridge which forms the abutment of the furrows in *T. striatopunctata*. There is some relationship between these two forms and *Octonaria muricata* Ulrich and Bassler. However, no pit has been observed in *Thlipsura* as far as the author is aware, and the arrangement of the furrows in *O. muricata* will not correspond with these forms. Furthermore, since *Octonaria* as a genus includes certain species with a straight hinge line as well as some that are subreniform in outline, it seems that a revision of the genus would be of benefit if enough material were at hand.

Holotype.—U. S. N. M. No. 80657.

Horizon and locality.—Middle Haragan marl, SW/NE sec. 28, T. 3 N., R. 6 E., Pontotoc Co., Okla.

THLIPSURA CURVISTRIATA, n. sp.
Plate 36, figs. 15 *a*, *b*

General outline of carapace subreniform. Dorsal aspect subrectangular. Maximum length is considerably closer to the ventral margin than to the dorsal margin. Maximum height is in the anterior half. Maximum width is in the plane of maximum length and extends for more than three-quarters of the length. Anterior extremity contains the curved furrow and the maximum height, thus distinguishing it from the posterior extremity. Right valve overlaps the left more or less continuously, excepting in the posterior extremity. Dorsal margin is convex and subangulate with a rather sharp hump, the point of maximum height. There is no special hingement discernible. Ventral margin is sinnuate, being slightly concave along the posterior half. Anterior extremity is bluntly curved. Posterior extremity is much sharper. The surface of the carapace is free of ornaments excepting for a crescentiform furrow, starting from the central portion and extending forward and downward toward the anterior ventral junction. The anterior portion of this furrow is surrounded by a lip which is quite prominent in its anterior extremity, but fades posteriorly on both sides of the furrow. This lip in its anterior termination drops off very sharply toward the junction or free margin of the two valves.

Dimensions.—Maximum length, 1.77 mm.; maximum height, 1.00 mm.; maximum width, 0.68 mm.

Generic and species relationships.—*T. Curvistriata* is related to *T. angulata* Jones and *T. plicata* Jones, the main difference being in the extent of curvature of the furrow.

Holotype.—U. S. N. M. No. 80660.

Horizon and Locality.—Upper Haragan marl, sec 4, T. 2 N., R. 6 E., Pontotoc Co., Okla.

THLIPSURA FOSSATA, n. sp.
Plate 36, figs. 16 *a-c*

General outline of carapace subreniform. Maximum length is approximately midway between the dorsal and ventral margins. Maximum height is slightly anterior to the center of the carapace. Maximum width is in the plane of maximum length and continues for about three-quarters of that length. The anterior extremity may be distinguished from the posterior in that it contains the largest depressed furrow. The greatest height is also found in the anterior half, which gives a broader curvature to this extremity. The right valve overlaps the left rather faintly. This overlap is most noticeable in the anterior dorsal portion and in the middle part of the ventral margin. The right valve contains a faint internal rabbetting along the whole ventral margin and this extends somewhat along the anterior extremity. There is a faint overlap also to be noted along the posterior dorsal portion. The dorsal margin is strongly convex with a slightly forward thrust. There is no indication of a hinge. The ventral margin is sinuate, being more or less parallel to the line of maximum length, but it is slightly concave just posterior to the line of maximum height. The anterior extremity is broadly curved; while the posterior extremity curves sharply from the dorsal to the ventral margins. The surface of the carapace is smooth, excepting for a small pit lying on the plane of maximum length and about three-quarters of the distance from the anterior to the posterior extremities. This small pit has a lip around its posterior moiety. In the anterior half of the carapace there is a very depressed furrow which curves slightly from the center of the carapace to the anterior portion of the ventral margin. The anterior portion of this furrow is surrounded by a very pronounced lip. Starting from the anterior ventral margin this lip rises and extends around the furrow, and then runs diagonally across the carapace towards the center of the dorsal margin fading out as it does so. The lip gives the anterior portion of the carapace a very blunt appearance when viewed from the dorsal or ventral margins.

Dimensions.—Maximum length, 1.90 mm.; maximum height, 1.13 mm.; maximum width, 0.77 mm.

Generic and species relationships.—This form is very similar to *T. curvistriata*, excepting that it has a posterior pit and the anterior furrow is curved in the opposite direction. This form appears to be

very closely related to *T. plicata,* var. *bipunctata* Jones. The only difference is in the relative smallness of the anterior furrow in *T. fossata. T. plicata* Jones does not have a posterior pit. *T. plicata,* var. *bipunctata* Jones has two posterior pits, one above the other. *T. fossata* and *T. muricurva* are the only forms which bear any relationships to *T. v-scripta* Jones and *T. v-scripta,* var. *discreta* Jones, but any similarities are very remote, being only in the general position of the furrow.

Holotype.—U. S. N. M. No. 80663.

Horizon and Locality.—Haragan marl, "White Mound", NE sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

THLIPSURA MURICURVA, n. sp.
Plate 37, fig. 17 *a*

This species differs from *T. fossata,* n. sp., in that this form is a trifle larger, the posterior pit is better developed, and the lip which runs along the posterior half of this pit is very much elongated as is the pit itself. The anterior furrow is smaller and the lip surrounding this furrow is much more prominent, extending across the carapace from the anterior ventral portion to the central portion of the dorsal margin. The main distinguishing feature of *T. muricurva,* n. sp., is the prominent central node situated just posterior to the plane of maximum height and a trifle below the plane of maximum length.

Dimensions.—Maximum length, 1.91 mm.; maximum height, 1.14 mm.

Generic and species relationships.—*T. muricurva* is very closely related to *T. fossata,* the difference being in the greater development of the anterior ridge and the posterior pit. The central node is another distinguishing feature in this form. *T. curvistriata* is similar, excepting that it has the one anterior furrow. *T. plicata,* var. *unipunctata* Jones is similar to *T. muricurva,* excepting that the latter has a central node and that its anterior furrow is not developed to the same extent.

Holotype.—U. S. N. M. No. 80662.

Horizon and Locality.—Base of Haragan marl, "White Mound", NE sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

THLIPSURA FURCA, n. sp.
Plate 37, figs. 18 *a-c*

General outline of carapace subreniform. Ovate in the dorsal aspect. Maximum length is midway between the dorsal and ventral

margin. Maximum height is slightly anterior to the central portion of the carapace. Maximum width is in the anterior half and in the plane of maximum length. The anterior extremity contains the peculiar ridges and furrows, thus distinguishing it from the posterior extremity. Right valve overlaps the left more or less throughout the entire margin, excepting for a small space on the posterior ventral margin. On the dorsal margin in the region of maximum height the valves meet in a slight depression. The dorsal margin is convex and slightly shoved forward. There is no hinge line discernible. Ventral margin is straight, excepting in the central portion where it is slightly concave. This is most noticeable in the left valve. Anterior extremity is very broad and is slightly angulate in its junction with the ventral margin. Posterior extremity is gently curved from the dorsal to the ventral margin. The anterior portion of each valve has a depressed area with two extensions toward the posterior. These extensions parallel the line of maximum length and extend from the line of maximum height forward half of the distance to the anterior extremity. They separate three flat-topped elevated protuberances extending forward, each of which terminates abruptly. The terminations make an inclined line when connected from the anterior ventral portion backward and up to the central part of the dorsal margin. The floor of the shelf together with two reëntrants or extensions are ornamented with minute papillae. The rest of the valve is free of all other ornamentation.

Dimensions.—Maximum length, 0.91 mm.; maximum height, 0.59 mm.; maximum width, 0.51 mm.

Generic and species relationships.—This species is almost identical with *T. corpulenta* Jones and Holl, the difference being in that *T. furca* has two reëntrants and three ridges in the anterior ornamentation, while *T. corpulenta* Jones and Holl has only one reëntrant and two ridges. This form is also related to *T. parallela* if one were to imagine the two reëntrants to be extended and then shut off anteriorly. The ornamented depressions are a character common to both, and also to *T. striatopunctata.* The latter form also bears the same relationship in its parallel furrows to *T. furca.*

Holotype.—U. S. N. M. No. 80664.

Horizon and Locality.—Lower Haragan marl, "White Mound", NE sec. 20, T. 2 N., R. 3 E., Murray Co., Okla.

THLIPSURA PRIMITIVA, n. sp.
Plate 37, figs. 19 *a-c*

General outline of carapace subreniform. Maximum length is midway between the dorsal and ventral margins. Maximum height is in the anterior quarter. Maximum width is in the anterior quarter and in the plane of maximum length. The anterior end is the bluntest and contains the transverse ridges and maximum height. In this way it may readily be distinguished from the posterior extremity. The right valve overlaps the left faintly along the ventral and anterior margins. There is also a faint overlap on the dorsal part of the posterior extremity. A faint depression may be noted along the anterior portion of the dorsal margin. The dorsal margin is convex throughout, excepting on the anterior extremity where it drops down very sharply to meet the ventral margin. The whole effect of the carapace is wedge-like. There is no definite hinge line. The ventral margin is more or less straight except in some forms where it is slightly concave in the central portion. The surface of the carapace is smooth except for a right-angled flange which is slightly inclined backward from the ventral to the dorsal margin. The anterior face of this flange is very steep; in fact, it is a right angle, thus leaving a very thin portion of the carapace extending forward to make the anterior extremity.

Dimensions.—Maximum length, 0.51 mm.; maximum height, 0.37 mm.; maximum width, 0.30 mm.

Generic and species relationships.—This form has no close affinities. The transverse ridge is quite characteristic of the genus. The straightness of the ridge is shared with *T. striatopunctata,* and the line marking the termination of the ridges in *T. furca* occupies the same position. A line comparable to this ridge may be drawn in *T. striatopunctata* and may be faintly represented in *T. corpulenta* Jones and Holl.

Holotype.—U. S. N. M. No. 80661.

Horizon and Locality.—Upper Haragan marl, sec. 4, T. 2 N., R. 6 E., Pontotoc Co., Okla. Middle Haragan marl, SW/NE sec. 28, T. 3 N., R. 6 E., Pontotoc Co., Okla.

Genus PHANASSYMETRIA, n. gen.

PHANASSYMETRIA TRISERRATA, n. gen. and n. sp.
Plate 37, figs. 20 *a-c*

General outline of carapace subreniform when viewed from the side. The dorsal view shows the carapace to be more or less wedge-

shaped with the widest part in the anterior. The end views of this genus are most unusual. They may best be seen by referring to the photograph. Maximum length is midway between the dorsal and ventral margins. Maximum height is approximately midway between the anterior and posterior extremities. Maximum width is in the anterior quarter and below the plane of maximum length. The anterior end is arbitrarily chosen to be that end which is the widest as there is no criteria which can clearly be applied to this form in describing the anterior and posterior extremities or the right and left valves. Hence the author has chosen the right valve as being the one to overlap the left. Valvular overlap.—The right valve is very much larger than the left and completely overlaps it on all margins. The dorsal margin of this species is straight and the right valve is rabbetted to receive the left. Its length is more than half the maximum length of the carapace. The anterior area of this margin is sharply depressed into a V-like trough. Just posterior to the maximum height and situated upon the sloping depression of the right valve into the hinge line, there is a slight protuberance, and in most forms this is also duplicated in the left valve, although very faintly. This characteristic seems to be universal even though the protuberances are quite small. The hingement is very simple. There appears to be no dentition. The ventral margin is slightly sinuate, although more or less paralleling the dorsal margin. The ventral margin is rather hard to distinguish because of the pronounced asymmetry shown in the carapace. Anterior extremity is slightly angulate about the line of maximum length and is quite blunt. The posterior extremity is more or less the same. It is, however, more angulate where it joins the dorsal margin. There is less overlap on this extremity than upon any of the others. Surface ornaments.—The carapace seems to be smooth. However, some forms show very faint striations when observed under high magnification. The right valve on the dorsal part has a very sharp depression which is surrounded by a rather pronounced shoulder on all sides but the anterior. The left valve has a shoulder in place of this depression. The ventral side of both the right and left valves has a rather pronounced shoulder. This gives the carapace a rather square appearance when viewed from either end, especially the left side. The right valve has three shoulders parallel to the maximum length and the left valve has two. All of these shoulders rise and become prominent toward the anterior; while in the posterior they fade and disappear, thus causing the very unusual appearance of the carapace.

Dimensions.—Maximum length, 1.05 mm.; maximum height, 0.75 mm.; maximum width, 0.86 mm.

Generic relationships.—Nothing has been found in the literature which might be taken to resemble this form in any way. Its very pronounced asymmetry, both in the surface ornamentation and in the manner of overlap, separate this form from any that have so far been described. There is a faint relationship to some of the species listed under Thlipsuridae. However, the inequivalved character and the straight hinge line are distinctive in this form.

Holotype.—U. S. N. M. No. 80670.

Horizon and Locality.—Basal Haragan marl, "White Mound", sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

PHANASSYMETRIA QUADRUPLA, n. sp.
Plate 37, figs. 21 *a-c*

General outline of carapace when viewed from the side subreniform. Dorsal aspect is pronouncedly wedge-shaped with the widest part in the anterior. Maximum length is midway between the dorsal and ventral margins. Maximum height is in the right valve and slightly anterior to the central portion. Maximum width is not at right angles to the maximum height, but is between the two ventral shoulders and in the anterior half. The anterior end is again arbitrarily chosen as that end which is the most tumid. Valvular over-

EXPLANATION OF PLATE 37

FIGS. 17 *a.*—*Thlipsura muricurva*, n. sp. Right valve, ×20.

18 *a–c.*—*Thlipsura furca*, n. sp. *a*, Left valve, ×30; *b*, anterior extremity, ×30; *c*, dorsal aspect, ×30.

19 *a–c.*—*Thlipsura primitiva*, n. sp. *a*, Posterior extremity, ventral margin toward the top, ×30; *b*, left valve, ×30; *c*, dorsal aspect, ×30.

20 *a–c.*—*Phanassymetria triserrata*, n. gen. and n. sp. *a*, Left valve, ×30; *b*, dorsal view, ×30; *c*, anterior extremity, ×30.

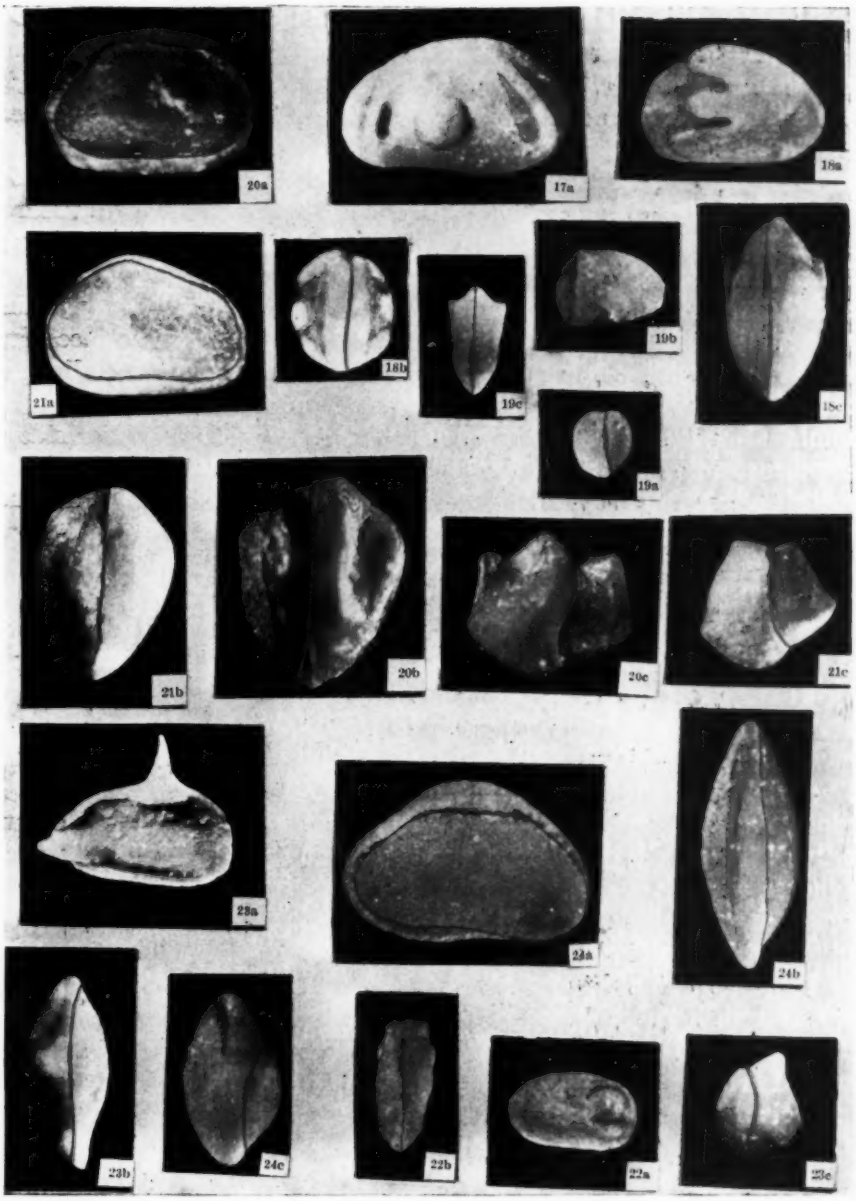
21 *a–c.*—*Phanassymetria quadrupla*, n. sp. *a*, Left valve, ×20; *b*, dorsal aspect, ×20; *c*, anterior extremity, ×20.

22 *a, b.*—*Craterellina moorei*, n. sp. *a*, Right valve, ×30; *b*, dorsal aspect, ×30.

23 *a–c.*—*Janusella biceratina*, n. gen. and n. sp. *a*, Right valve, ×20; *b*, dorsal aspect, ×20; *c*, anterior extremity, ×20.

24 *a–c.*—*Bythocypris transversa*, n. sp. *a*, Right valve, ×30; *b*, dorsal aspect, ×30; *c*, posterior extremity, ×30.

All dorsal and ventral aspects are so orientated that the anterior extremity is pointing toward the top of the plate.


20a
17a
18a
21a
18b
19c
19b
19a
21b
20b
20c
21c
23a
22a
24b
23b
24c
22b
22a
23c

lap.—The right valve overlaps the left very markedly on all free margins, except the posterior extremity in which the overlap is not so pronounced. The dorsal margin as in *P. triserrata,* is straight. The right valve is slightly rabbetted so that it may receive the left. The area of hingement is about half the maximum length and occupies a very sharp depression as both the right and left valves slope down to it. This area of depression is not ornamented with a tubercle as was the same depression in *P. triserrata.* Hingement is very simple. The ventral margin is again difficult to define. However, the free edge of the right valve more or less parallels the hinge line. The anterior and posterior extremities are very blunt. Surface ornaments.—The right valve has a shoulder paralleling the hinge line and is very prominent in the region of maximum height. The left valve has a similar shoulder, but is much smaller. On the ventral side of the right valve there is another similar shoulder which is not nearly as pronounced. The corresponding ridge in the left valve is much more prominent. This character gives the peculiar appearance of the carapace which, when viewed from either the anterior or posterior extremities, is widest below and narrowest above. Certain of the forms, which seem to have weathered somewhat differently, show a decidedly pitted carapace. This may be a universal feature, but is obscured in most of the forms. No other ornaments were noted upon the carapace.

Dimensions.—Maximum length, 1.59 mm.; maximum height, 1.00 mm.; maximum width, 1.13 mm.

Species relationship.—This form undoubtedly belongs to the same genus as *P. triserrata.* There are, however, some major differences which may be readily seen in examining the photographs. The size and pitted character are quite different.

Holotype.—U. S. N. M. No. 80671.

Horizon and Locality.—Basal Haragan marl, "White Mound", NE/c sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

Genus CRATERELLINA Ulrich and Bassler

CRATERELLINA MOOREI, n. sp.

Plate 37, figs. 22 *a, b*

General outline of carapace subovate to subreniform. Slightly compressed in the posterior extremity. Maximum length is somewhat closer to the ventral than to the dorsal margin. Maximum height is midway between the anterior and posterior extremities. Maximum

width is in the line of junction between the maximum length and the maximum height. Anterior extremity contains the crater-like depression, thus distinguishing it from the posterior extremity. The right valve overlaps the left along the anterior extremity, the posterior dorsal extremity, and in the central part of the ventral margin. Dorsal margin is arcuate, usually quite evenly curved. Hingement is not discernible. Ventral margin is sinuate and slightly concave in the central portion. Anterior extremity bluntly curved. Posterior extremity more evenly curved than the anterior. The posterior portion of the carapace slightly tapers. Surface ornaments consist of a large subcircular groove which does not quite connect in the central part of the posterior half. This circular groove or crater is surrounded by a pronounced lip which is quite prominent around the anterior half. The posterior half is much depressed. The part surrounded by the groove is elevated and connects with the rest of the carapace through a very narrow isthmus. The circular groove is irregularly depressed in certain parts. There are no other ornaments upon the carapace.

Dimensions.—Maximum length, 0.64 mm.; maximum height, 0.37 mm.; maximum width, 0.29 mm.

Species relationships.—This form is very closely related to *Craterellina oblonga* Ulrich and Bassler. It differs, however, in that its crater is larger, the general outline is more subreniform, and no pits were noted upon the surface of the carapace. The general construction of the crater is much different in *C. moorei* from what it is in *C. oblonga.*

This species is named after Dr. R. C. Moore of the University of Kansas. Dr. Moore contributed some very valuable information relative to this paper.

Holotype.—U. S. N. M. No. 80650.

Horizon and Locality.—Basal Haragan marl, "White Mound", NE/c sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

Family BEECHERELLIDAE Ulrich

Genus JANUSELLA, n. gen.

JANUSELLA BICERATINA, n. gen. and n. sp.

Plate 37, figs. 23 *a-c*

General outline of carapace subovate. Maximum length is approximately midway between the dorsal and ventral margins. Maximum

height may be taken through the dorsal spine. Maximum width is approximately midway between the anterior and posterior extremities and well down toward the ventral margin. Orientating the form the same as in the genus *Krausella* Ulrich, we have the highest end in the anterior. The posterior end of the smallest or right valve has a prolongation or spine. Valvular overlap.—The left valve overlaps the right principally along the posterior dorsal portion and the ventral portion. This overlap, however, seems to be somewhat different from that in *Krausella* in that the left valve does not have the rolled-up lip which overlaps the right valve. Except for the spine the dorsal margin is curved throughout. This curvature is more pronounced toward the anterior extremity. The hinge line is very elementary and probably confined to the region immediately below the dorsal spine of the left valve. The contact between the two valves is marked by a slight depression in this vicinity. Ventral margin appears to be quite straight, although it is curved slightly. This curvature is very pronounced toward the anterior. Anterior extremity is symmetrically rounded, the right valve being just faintly smaller than the left. Posterior extremity is rather sharply angulate. The prolongation of the right valve into the spine somewhat depresses the left valve; while just above this spine the left valve overlaps the right a little more prominently than elsewhere. The spine of the right valve is inclined somewhat away from the plane of junction of the two valves. Surface ornaments of the carapace consist of two spines. One, which is inclined usually a little toward the rear, is on the dorsal part of the left valve. In most cases this spine is broken off. The right valve has a spine projecting away from and out of the ventral posterior extremity. This spine is not quite as prominent as the one on the dorsal margin. There are no other ornaments.

Dimensions.—Maximum length including spine, 1.59 mm.; maximum height including spine, 1.22 mm.; maximum width, 0.72 mm.

Generic relationships.—This form seems to be very rare inasmuch as only three specimens have been found in the material studied. Its relationships are rather complex. In its peculiar ornaments it might be called a hybrid, which has resulted from the union of a *Krausella* and an *Aechmina;* at least the right valve very closely resembles the right valve of a *Krausella,* while the situation of the dorsal spine recalls *Aechmina.* Further than that there is no form published which might resemble this genus in any respect.

The apparent two-faced character of this form suggested to the author the name *Janusella* after the two-faced Roman God Janus.

Holotype.—U. S. N. M. No. 80665.

Horizon and Locality.—Basal Haragan marl, "White Mound", NE/c sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

Family BAIRDIIDAE

Genus BYTHOCYPRIS Brady

BYTHOCYPRIS TRANSVERSA, n. sp.

Plate 37, figs. 24 *a-c*

General outline of carapace from the side view is subreniform. End view is subelliptical. Maximum length is a trifle closer to the ventral than to the dorsal margin. Maximum height is slightly posterior to the central portion of the carapace. Maximum width is in the central part of the carapace. The orientation of the carapace may best be noted by the overlap, as the left valve very strongly overlaps the right. The dorsal margin is strongly arched, especially in the central portion as the anterior and posterior parts have about an equal inclination toward the maximum length. The central part of the dorsal margin of the right valve is straight. Undoubtedly this forms the area of articulation of the two valves. Hingement could not be observed. The ventral margin is sinuate and is quite concave in the anterior half where the left valve very faintly overlaps the right. Anterior extremity is bluntly curved. The posterior extremity appears a trifle more angulate. Surface ornaments are simple. The right valve contains none. The left valve has a faint groove which is just about opposite and parallel to that portion which was designated as the hinge line on the right valve. The area of the carapace above this groove constitutes that portion of the left valve which extends so much above the right valve. Otherwise the carapace is smooth.

Dimensions.—Maximum length, 1.21 mm.; maximum height, 0.81 mm.; maximum width, 0.48 mm.

Generic and species relationships.—This form greatly resembles *B. phillipsiana* Jones and Holl, excepting for the transverse groove on the left valve and the straight hinge line on the right valve. This straight hinge line on the right valve gives a Bairdian aspect to the carapace, and thus it bears a close relationship to *Bairdia phillipsiana* Jones and Holl.

Holotype.—U. S. N. M. No. 80652.

Horizon and Locality.—Basal Haragan marl, "White Mound", NE/c sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

BYTHOCYPRIS SIMPLEX, n. sp.
Plate 38, figs. 25 *a, b*

General outline of carapace subovate. Dorsal aspect somewhat wedge-shaped. Maximum length is midway between the dorsal and ventral margins. Maximum height is midway between the anterior and posterior extremities. Maximum width is just below the plane of maximum length and posterior to the maximum height. The carapace is very tumid and the widest portion may be taken as the posterior. The left valve overlaps the right very uniformly, being greatest along the ventral margin. Hingement was not discernible. The dorsal and ventral margins are broadly convex. There is no very clear demarcation between these margins. The anterior and posterior extremities are gently curved. Surface ornaments are absent, the carapace being very smooth.

Dimensions.—Maximum length, 1.40 mm.; maximum height, 0.83 mm.; maximum width, 0.81 mm.

Generic and species relationships.—The form described is very closely related to *B. phillipsiana* Jones and Holl. The difference is that *B. phillipsiana* does not show the wedge-shaped character and is more compressed in the anterior portion than the form described. It is also quite similar to *Cytherella* in its manner of overlap.

Holotype.—U. S. N. M. No. 80646.

Horizon and Locality.—Basal Haragan marl, "White Mound", NE/c sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

Genus PONTOCYPRIS Sars

PONTOCYPRIS SMITHI, var. MAGNA, n. var.
Plate 38, figs. 26 *a, b*

General outline from the side subreniform. The end view elliptical. Maximum length is a little more than halfway from the dorsal to the ventral margin. Maximum height is just anterior to the central portion of the carapace. Maximum width is approximately in the central portion. The anterior end is chosen as that end which contains the maximum height. The valvular overlap could not be studied as a complete carapace was not found, although several perfect valves were obtained. From a study of these valves it seems that on the ventral margin in that portion where it is concave, the right valve probably slightly overlaps the left as is the case in *P. smithi.* Dorsal margin is broadly convex, the anterior slope being somewhat steeper. There is no hingement discernible. The ventral margin is sinuate, its anterior portion being convex and its posterior portion concave.

The anterior extremity is bluntly curved; the posterior extremity is more angulate. Surface ornaments are entirely wanting. The only thing of note being that the valves are quite delicate, which would account for their poor preservation.

Dimensions.—Maximum length, 2.45 mm.; maximum height, 1.27 mm.

Generic and species relationships.—This form appears to be identical with *P. smithi* described by Dr. T. R. Jones. The difference between the two being that the form described here is more than twice as large as the one described by Dr. Jones.

Holotype.—U. S. N. M. No. 80643.

Horizon and Locality.—Upper Haragan marl, sec. 4, T. 2 N., R. 6 E., Pontotoc Co., Okla. Middle Haragan marl, SW/NE sec. 28, T. 3 N., R. 6 E., Pontotoc Co., Okla.

Family CYTHERELLIDAE Sars

Genus CYTHERELLA Jones

CYTHERELLA QUAESITA, n. sp.

Plate 38, figs. 27 *a-c*

General outline of carapace subelliptical. Maximum length is midway between the dorsal and ventral margins. Maximum height is about one-third of the distance between the anterior and posterior extremities. Maximum breadth is in the plane of maximum length and slightly anterior to the posterior extremity. The anterior end may be readily defined as the thinnest end, and also as the end containing the maximum height. Valvular overlap.—The right valve prominently overlaps the left along the dorsal and ventral margins, but less so along the anterior and posterior extremities. Dorsal margin is slightly depressed towards the posterior and is broadly curved at its anterior and posterior terminations. Hingement is not discernible. Ventral margin is exactly similar to the dorsal margin only it is reversed. Anterior extremity is broadly curved. Posterior extremity is also broadly curved; however, the junction between the two valves is marked by a rather pronounced ridge which is quite sharp and is formed by the overlapping of the right valve. Surface ornaments are simple. There are no false keels, nor any true shoulders. However, each valve at its posterior termination contains a very well elevated ridge gently rising from the anterior to the posterior. Its posterior terminations are exceedingly abrupt, being

almost at right angles. In the extreme posterior portion there is a slight elevation again at the junction of the two valves. The surface of the carapace appears to be smooth. Just above the line of maximum length and about midway between the anterior and posterior extremities there occurs a depressed area or pit. This character is well shown on both valves. There are no other ornamentations.

Dimensions.—Maximum length, 1.05 mm.; maximum height, 0.59 mm.; maximum breadth, 0.48 mm.

Generic and species relationships.—This form has several points which make it rather difficult to place it in the genus *Cytherella,* namely: the marked developments or ridges around the posterior extremity and the two pits. In this respect it shows a similarity to *Cytherella ovatiformis* Ulrich. *Cytherella quaesita* shows the marked overlap of the left valve by the right valve which is so characteristic of the genus *Cytherella.* There are no forms to which it may be closely allied. Because of its questionable relationships the author has chosen this specific latin name.

Holotype.—U. S. N. M. No. 80644.

Horizon and Locality.—Basal Haragan marl, "White Mound", NE/c sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

EXPLANATION OF PLATE 38

FIGS. 25 *a, b.*—*Bythocypris simplex,* n. sp. *a,* Right valve, ×30; *b,* posterior extremity, ×30.

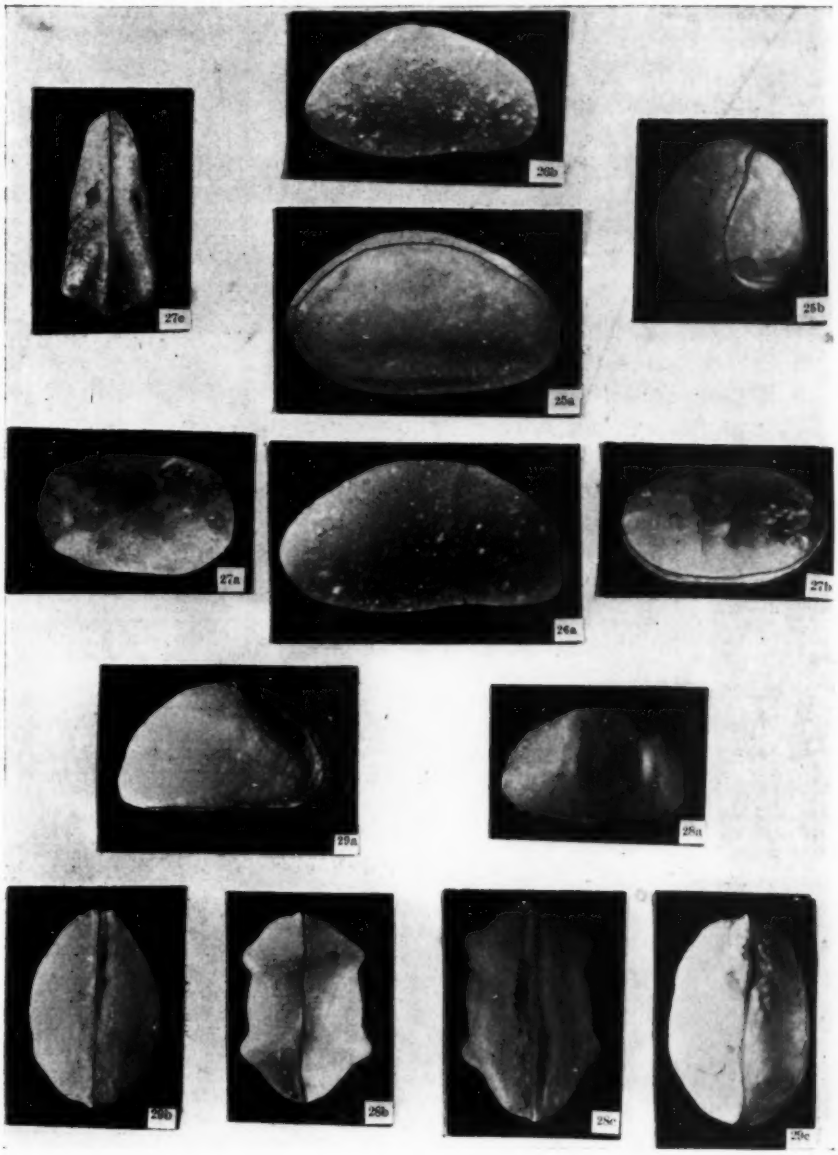
26 *a, b.*—*Pontocypris smithi,* var. *magna,* n. var. *a,* Left valve, ×20; *b,* smaller left valve, ×20.

27 *a–c.*—*Cytherella quaesita,* n. sp. *a,* Right valve, ×30; *b,* left valve, ×30; *c,* dorsal aspect, ×30.

28 *a–c.*—*Condracypris binoda,* n. gen. and n. sp. *a,* Right valve, ×20; *b,* dorsal aspect, ×20; *c,* ventral aspect, ×20.

29 *a–c.*—*Condracypris simplex,* n. sp. *a,* Right valve, ×20; *b,* ventral aspect, ×20; *c,* dorsal aspect, ×20.

All dorsal and ventral aspects are so orientated that the anterior extremity is pointing toward the top of the plate.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27c
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25c

Family CYPRIDAE Zenker

Genus CONDRACYPRIS, n. gen.

CONDRACYPRIS BINODA, n. gen. and n. sp.

Plate 38, figs. 28 *a-c*

General outline of carapace side view subtrapezoidal. End view subrectangular. Maximum length may be taken about two-thirds of the distance from the dorsal side to the ventral side. Maximum height may be taken about one-third of the distance from the anterior to the posterior extremity. Maximum width may be taken between the two posterior transverse ridges or nodes and is well down toward the ventral side. The simplest method for orientating this form is to place the widest part in the posterior which places the maximum height in the anterior. This form shows no valvular overlap excepting very faintly along the ventral margin at which point the left valve slightly overlaps the right. This overlap is more in the fashion of the left valve having a little higher development of the free margin. The right valve is faintly grooved along this contact. Dorsal margin is broadly acuminate. Just posterior to the maximum height there is a faint depression at the junction of the two valves. This depression extends for about one-sixth of the maximum length. There is no hingement developed as far as can be determined. Ventral margin is straight, although it is slightly depressed for a short length in the region of maximum height. The ventral margin is almost as long as the maximum length. Anterior extremity is bluntly curved. The free margin of both valves is marked by a lip which starts on about the line of maximum length. The posterior extremity is more angulate than the anterior, but only so where it joins the ventral margin. Surface ornaments consist only of two transverse ridges on each valve. The anterior one of these is about a quarter of the distance from the anterior to the posterior extremity; while the other transverse ridge is about two-thirds the distance from the anterior to the posterior extremities. These ridges are quite pronounced. The posterior slope of the posterior ridge and the anterior slope of the anterior ridge are very gentle. The two other slopes are very pronounced, but this character is variable. Neither of the ridges reach the dorsal or the ventral margins. They attain their greatest prominence just above the line of maximum length. There are no other ornaments, excepting the small lip on the ventral margin.

Dimensions.—Maximum length, 1.86 mm.; maximum height, 1.00 mm.; maximum width, 1.22 mm.

Generic relationships.—The literature has no form comparable to this genus. The shell is too massive to fall under the genus *Pontocypris. Bythocypris* has the left valve considerably larger than the right and overlapping it. The ventral margin is usually convex. *Macrocypris* is a more elongate form. Its general outline is much different. The surface ornaments clearly distinguish *Condracypris* from any forms which may be closely related to it.

This interesting genus is named after Dr. Condra of the Nebraska Geological Survey.

Holotype.—U. S. N. M. No. 80667.

Horizon and Locality.—Basal Haragan marl, "White Mound", NE/c sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

CONDRACYPRIS SIMPLEX, n. sp.
Plate 38, figs. 29 *a-c*

General outline of carapace from side view subtrapezoidal. End view subelliptical. Very tumid and flattened along the ventral margin. Maximum length is about two-thirds of the distance from the dorsal to the ventral margin. Maximum height lies in the anterior third. Maximum width is approximately midway between the dorsal and ventral margins and a little posterior to the center of the carapace. The anterior end is taken as that end which contains the maximum height. The posterior end is the widest. This carapace has the same overlap as was noted in *C. binoda:*—the left slightly overlapping the right along the ventral margin. Dorsal margin is broadly arcuate, the steepest slope being in the anterior. This species also has the same slight depression just posterior to the maximum height as was noted in *C. binoda.* There are no evidences of any hingement. Ventral margin is straight throughout most of its length, but in the anterior portion it is slightly concave. The anterior extremity is rather bluntly angulated. The lip on the free margin runs the same in this species as it does in *C. binoda.* The posterior extremity joins the ventral margin at a much sharper angle. Each valve is very broadly tumid. Surface ornaments are wanting.

Dimensions.—Maximum length, 1.77 mm.; maximum height, 1.09 mm.; maximum width, 1.09 mm.

Generic and species relationships.—This form is very closely related to *C. binoda,* the only difference being the absence of the two transverse ridges or nodes. In all other respects they are identical. This difference in ornamentation may represent a difference in the

sex of the two forms. However, there is no indication to prove this point.

Holotype.—U. S. N. M. No. 80666.

Horizon and Locality.—Basal Haragan marl, "White Mound", NE/c sec. 20, T. 2 S., R. 3 E., Murray Co., Okla.

ADDITIONAL NEW SPECIES OF TERTIARY LARGER FORAMINIFERA FROM JAMAICA

THOMAS WAYLAND VAUGHAN
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ABSTRACT

This paper presents descriptions of new species collected by Dr. C. A. Matley in Jamaica as follows: *Yaberinella trelawniensis*, upper Eocene, *Camerina matleyi*, middle Eocene, *Camerina* sp., upper Eocene, *Borelis matleyi*, middle Eocene, *B. jamaicensis*, middle Eocene, *B. jamaicensis*, var. *truncata*, middle Eocene, and *Amphisorus matleyi*, Miocene. A figure of the marginal apertures of *Amphisorus americanus* (Cushman) Vaughan is introduced for comparison with figures of *A. matleyi*. The presence of species of *Operculina*, *Operculinella*, *Heterostegina*, *Archaias*, and *Peneroplis* are noted but without the identification of species.

INTRODUCTION

Last year I published in this Journal two articles on the larger foraminifera collected by Dr. C. A. Matley in the Tertiary deposits of Jamaica (Vaughan, 1, 2). The present paper is intended to complete the description of the identifiable species except some specimens that represent a genus related to *Coskinolina* but for which the needed sections have not yet been prepared. A supplemental note on them will, therefore, be necessary.

Nearly all the material collected by Dr. Matley is indurated and the specimens, therefore, must mostly be studied in thin sections. For this reason specific determinations of many specimens have not been attempted. Among the genera represented by such specimens are *Operculina*, *Operculinella*, and *Heterostegina*. After sections have been studied of specimens free from matrix from other localities it may be possible to identify some of the specimens represented in the

sections. Since the three genera above mentioned range from the Eocene to the present, listing unidentified species renders no assistance in solving stratigraphic problems. Therefore, the localities for such species are not given in this paper.

According to the understanding with Doctor Matley the actual types of species described from his collection will be deposited in the United States National Museum and the first set after the types will be deposited in the British Museum (Natural History). It is expected to retain at the Scripps Institution of Oceanography duplicate specimens of most, if not all, of the species.

DESCRIPTION OF SPECIES

Family LITUOLIDAE

Genus YABERINELLA Vaughan

YABERINELLA TRELAWNIENSIS Vaughan, n. sp.
Plate 39, fig. 1

The tests of the megalospheric form are compressed involute coils, very similar in external features to those of *Y. jamaicensis* Vaughan. Dimensions of apparently adult specimens: Greater diameter, 5 mm.; lesser diameter, 4 mm.; thickness, about 0.50 mm. In form and size there is no noteworthy difference from *Y. jamaicensis*.

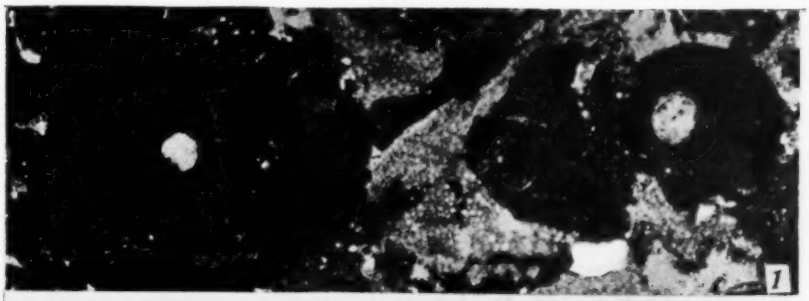
The initial chamber is elliptical or ovoid. The large one illustrated by pl. 39, fig. 1, is 0.40 by 0.35 mm. in diameter, smaller than in *Y. jamaicensis*.

EXPLANATION OF PLATE 39

(The locality numbers are explained under the description of the different species.)

FIG. 1.—*Yaberinella trelawniensis* Vaughan, n. sp. Horizontal sections through the embryonic chambers of two specimens and a section of part of another specimen, ×17½. Sections of parts of specimens of species of *Asterocyclina* sp. and *Lepidocyclina sherwoodensis* Vaughan also in the figure. From locality J. 57 M.

2–5.—*Camerina matleyi* Vaughan, n. sp. Figs. 2, 3, exteriors of 6 specimens, ×8¾. Figs. 4, 5, horizontal sections, ×29¾, fig. 4 of the thinner, fig. 5 of the thicker variants. Figs. 6, 7, vertical sections, ×29¾, fig. 6 of the thinner, fig. 7 of the thicker variants. All specimens from locality J. 605 M., except those for fig. 3, which are from J. 505 M.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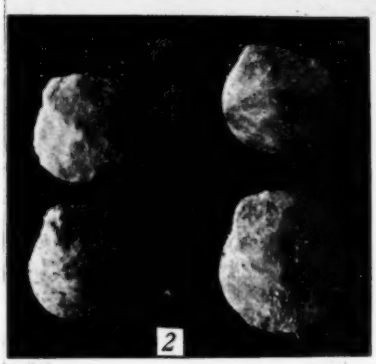
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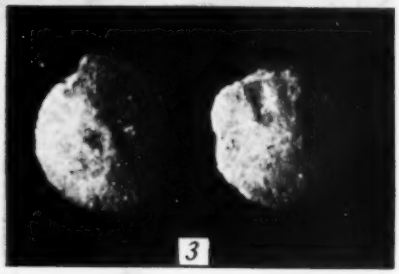
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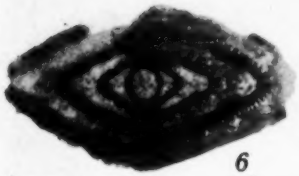
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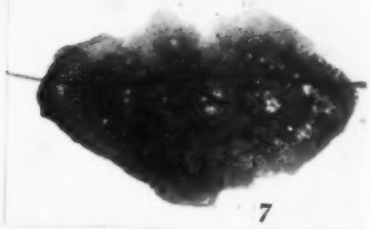
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The internal structure presents the criss-cross pattern characteristic of *Yaberinella*, but it tends to be more wavy than in *Y. jamaicensis* and the interspaces between the skeletal elements are rather narrower. The figures here given should be compared with pl. 5, fig. 1, of the original illustrations of *Y. jamaicensis* (Vaughan, 2).

Geologic Horizon and Locality.—Upper Eocene; J. 57 M., Sherwood, Trelawny, Jamaica; collected by Dr. C. A. Matley. *Lepidocyclina sherwoodensis* Vaughan is an associated species, as is also a species of *Discocyclina (Asterocyclina)*.

Cotypes.—U. S. National Museum.

Very marked differences between the form now described and *Yaberinella jamaicensis* are not obvious. The initial chamber of *Y. trelawniensis* seems to be smaller and because the interspaces between the skeletal elements are narrower the internal structure appears finer than that of *Y. jamaicensis*. The figures of the horizontal sections of the two forms illustrate the differences indicated.

Family CAMERINIDAE

Genus CAMERINA Brugière

CAMERINA MATLEYI Vaughan, n. sp.

Plate 39, figs. 2-7

Test small, lenticular, outer surface without ornamentation except the traces of flexuous septal markings. Diameter from 1.6 to 2.4 mm.; thickness from about 0.75 to 1.25 mm. Although the thickness varies, it is approximately one-half the diameter.

The number of coils in a specimen 1.75 mm. in diameter is about four, and the number of chambers in the last coil is about 33. The chamber walls are gently curved.

The specimens examined are all megalospheric.

Geologic Horizon and Locality.—Middle Eocene, "Yellow limestone", at J. 505 M., Phantillands parochial road, 1.8 miles from the main road, on the boundary of St. Elizabeth and Manchester parishes; and J. 605 M., Davyton road at 4⅞ miles, Peace River district, Clarendon Parish.

Types.—U. S. National Museum.

Although the foregoing description is brief, it and the accompanying figures are sufficient for discriminating between *C. matleyi* and any other species hitherto described from America. The only species with which comparison is needed is *N. parvula* Cushman from the upper Eocene of the Island of St. Bartholomew. *N. parvula* is fully

twice the size of *N. matleyi*, a specimen about 4 mm. in diameter having 4 or 5 coils. Cushman does not state what the number of chambers in the last coil is. From the figure of the type it seems to be about 27; that is, for its size there appear to be fewer chambers than in *N. matleyi*. Several American species are referable to *Operculinella* Yabe, of which *Nummulites cumingii* (Carpenter) is the genoholotype and which is characterized by a nummulitoid early stage followed by the projection of the last coil as a flange as in *Operculina*. The specimens of *Camerina matleyi* examined are all close-coiled.

CAMERINA sp.
Plate 40, fig. 1

Although *Camerina* is represented by numerous specimens in the sections of the rocks, it would be hazardous to attach names to them. A particularly fine specimen is illustrated by pl. 40, fig. 1. It is 6.25 mm. in diameter; 1.85 mm. thick; and there are 7 coils. The number of chambers to a coil is not known.

Geologic Horizon and Locality.—Upper Eocene, J. 58 M., west of borehole, Hyde, Trelawny; associated with *Dictyoconus puilboreauensis* Woodring, *Discocyclina, Asterocyclina, Lepidocyclina trinitatis* H. Douv., *L. macdonaldi* Cushman, and other species.

Family ALVEOLINELLIDAE

Genus BORELIS Montfort

There are at least two species of *Borelis* in the collections Doctor Matley made in the "Yellow limestone" of Jamaica. One of them is larger and its height is nearly the same as or even slightly greater than its transverse diameter; the other is smaller and its height is less than its transverse diameter. There may be more than two species but it appears to be unsafe to try to characterize more than these two.

BORELIS MATLEYI Vaughan, n. sp.
Plate 40, figs. 2, 3, 3 *a*

Test subellipsoidal with gently curved or somewhat flattened ends. Height slightly more than 3 mm.; diameter slightly less than 3 mm. Outer surface marked with distinct rather narrow revolving ridges, whose distance apart ranges about 0.10 to about 0.30 mm.

The longitudinal section, which is taken as the holotype, illustrated by pl. 40, fig. 2, is not quite axial. It shows seven coils and there are probably one or two more. The distance across six coils is 1.25 mm.,

giving an average width of each coil of about 0.21 mm. The chambers are divided into chamberlets by revolving partitions which are more crowded near the center, interspaces 0.05 mm. wide, than at the periphery, where the interspaces are from 0.10 to 0.15 mm. wide.

Localities.—On the boundary between the parishes of St. Elizabeth and Manchester at J. 503 M., Gentle Hill, at 1100 ft. descent; and J. 50 M., Phantillands parochial road, 1.8 mi. from the main road.

Types.—Holotype from J. 503 M., pl. 40, fig. 2; paratype from J. 505 M., pl. 40, figs. 3, 3 *a*, both in U. S. National Museum.

BORELIS JAMAICENSIS Vaughan, n. sp.
Plate 40, figs. 4-10

Test depressed, subglobular, height less than the transverse diameter. Height of cotype, 1 mm.; transverse diameter, 1.4 mm. Longitudinal sections of four specimens are illustrated on pl. 40, figs. 6, 7, 9, 10, and they give a good idea of the range in the variation of its shape. The outer surface is marked by low rather crowded revolving lines, the distance between their tops about 0.10 mm. These lines are not so prominent as and are closer together than the revolving ridges in *B. matleyi.*

Pl. 40, fig. 6, illustrates a longitudinal section of a cotype, a megalospheric specimen. The proloculum is 0.25 by 0.30 mm. in diameter. On the right of the proloculum as the figure is mounted nine coils are shown. The width of the chambers increases from about 0.05 mm. near the center to about 0.15 mm. at the periphery. The height of the chamberlets at the periphery ranges from about 0.10 to about 0.15 mm.

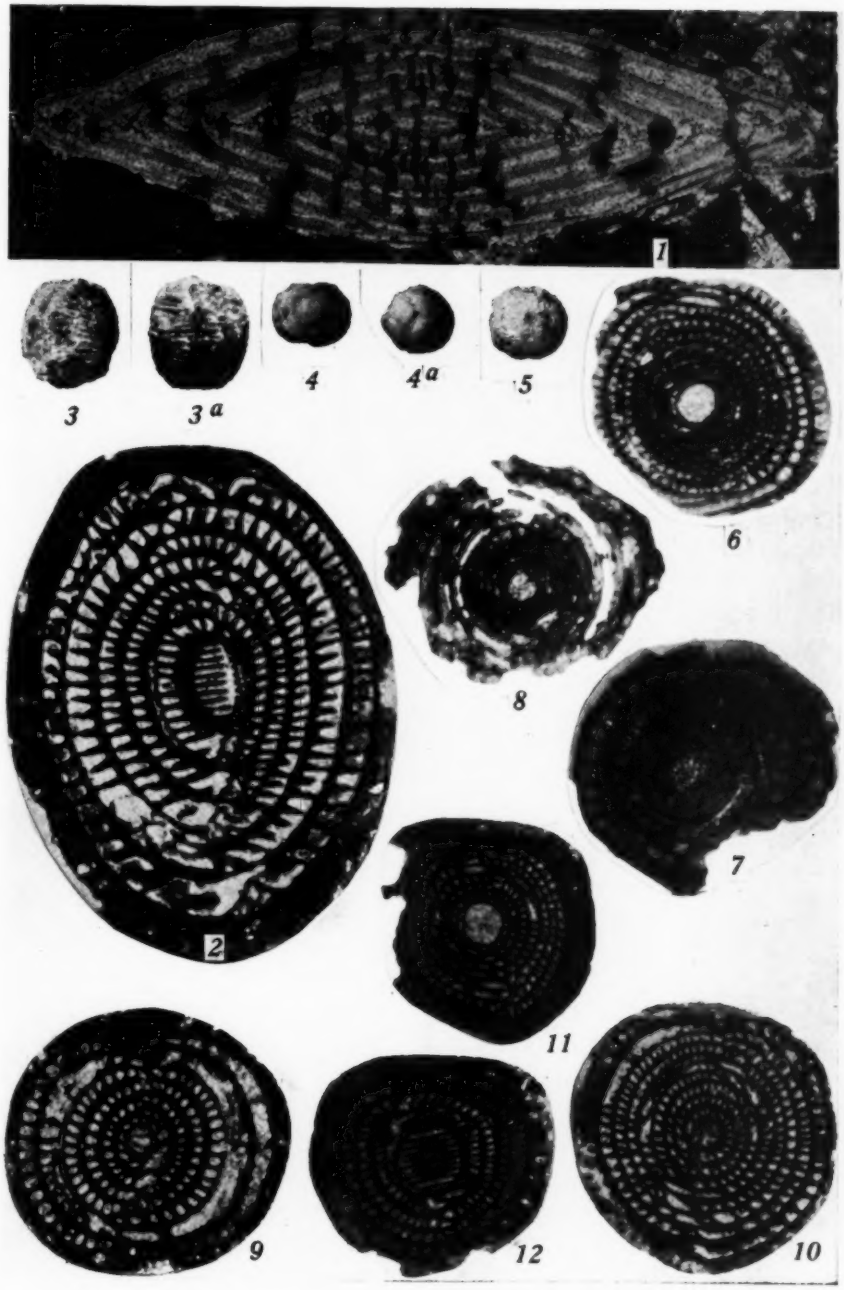
EXPLANATION OF PLATE 40

FIG. 1.—*Camerina* sp. Vertical section, ×17½, of a specimen from J. 58 M.

2, 3, 3 *a*.—*Borelis matleyi* Vaughan, n. sp. Fig. 2, longitudinal section of holotype, ×17½, from locality J. 503 M. Figs. 3, 3 *a*, two views of a paratype, ×4⅜, from J. 505 M.

4–10.—*Borelis jamaicensis* Vaughan, n. sp. Fig. 4, side view. Fig. 4 *a*, top view, ×4⅜, of the same specimen, a cotype, from J. 505 M. Fig. 5, side view, ×4⅜, of another specimen from the same locality. Fig. 6, longitudinal section of a cotype, ×17½, from same locality. Fig. 7, longitudinal section of a small specimen, ×29¾, from same locality. Fig. 8, transverse section of a cotype, ×17½, from the same locality. Figs. 9, 10, longitudinal sections of specimens in rock, ×17½; fig. 9 from J. 501 M., fig. 10 from J. 503 M.

11, 12.—*Borelis jamaicensis*, var. *truncata* Vaughan, n. var. Longitudinal sections of two specimens, ×20, in rock from J. 503 M.



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Localities.—On the boundary of the parishes of St. Elizabeth and Manchester at J. 501 M., Spice Grove, near head of spring; J. 503 M., Gentle Hill, at 100 ft. descent; J. 504 M., Spice Grove; J. 505 M., Phantillands parochial road, 1.8 mi. from the main road.

Types.—Cotypes, three selected specimens, pl. 40, figs. 4, 4 *a*, 6, 8, from J. 505 M. Paratypes from J. 501 M. and J. 504 M., pl. 40, figs. 5, 7, 9, 10; all in the U. S. National Museum.

BORELIS JAMAICENSIS, var. TRUNCATA Vaughan, n. var.
Plate 40, figs. 11, 12

There are specimens in the thin sections that are flattened at one end and rounded at the other. Except in shape they appear not to differ from the usual specimens of *B. jamaicensis*, with which they occur in the same thin sections. Furthermore, the two forms seem to intergrade. Therefore, the specimens with one end flattened are considered as variants of *B. jamaicensis*.

Locality.—J. 503 M. (for explanation of number, see above).

Cotypes.—U. S. National Museum.

The foregoing descriptions are defective in that no notes are given on the apertures on the growing edge of the outer coil. The specimens have been infiltrated and both tests and the infiltrated material have been recrystallized. The apertures, therefore, are not clearly recognizable. It appears that they are in multiple rows in both *B. matleyi* and *B. jamaicensis*, but of this I could not be sure.

Family PENEROPLIDAE

Genus AMPHISORUS Ehrenberg

AMPHISORUS MATLEYI Vaughan, n. sp.
Plate 41, figs. 1-4

Test subdiscoidal, outline circular, thicker at the margin than in the center. Diameter of the cotypes (pl. 41, fig. 1), from about 8 to 10 mm.; of a paratype (pl. 41, fig. 3), 17 mm. Thickness at the edge of large specimens 0.75 mm., nearly 1 mm.

Width of annuli about 0.1 mm.; chambers rectangular, radial length the same as the width of the annuli, transverse width about half the length.

Marginal apertures in a slightly depressed band which is bounded on each side by a slight ridge and its width is about one-third the thickness of the test. In tests of the size of the cotypes there are

three rows of apertures in the apertural zone, one near each outer side of the zone and an intermediate row. The diameter of the apertures ranges from about 15 to 25 μ.

Geologic Horizon and Localities.—Miocene, the *Sorites* zone of Dr. Matley (quoted, Vaughan 1, p. 279) at localities in the Parish of St. Elizabeth as follows:

J. 306 M., Santa Cruz Mountains, bridle track from Stanmore to Mountainside, about 100 ft. descent or less.

J. 313 M., Santa Cruz Mountains, Unity Hill at 24½ mi. The cotypes.

J. 314 M., Santa Cruz Mountains, Unity Hill at 19 mi.

J. 321 M., Punch Bowl, at steep ascent on main road from Myersville. Paratype.

J. 322 M., Parochial road to Pepper, at Friendship.

J. 324 M., Road from Lacovia bridge toward Magotty, at one-tenth mi. above 74 mi.-post.

J. 325 M., Breadnut valley, Maggoty road at 1½ mi.

The species may be represented in material from other localities, but I have listed only those of which I am confident. Associated with it are specimens of *Penoroplis* and *Archaias*, as would be expected, but the specimens of those genera are not in satisfactory condition for specific identification.

Types.—U. S. National Museum.

Doctor Matley has called the horizon of this species the *Sorites* zone, because I referred the specimens to *Sorites*, following the usage of Professor H. Douvillé. *Sorites*, however, has a single row of marginal apertures, while the present species has treble rows and should be referred to *Amphisorus*. Ehrenberg's *Amphisorus* has apertures in two rows, but, for some species at least, whether there are only two rows or more than two depends on the growth stage of the specimen. The marginal apertures are of critical significance in the definition of species of *Amphisorus*.

There is only one described American species with which *A. matleyi* needs to be compared. It is *Orbitolites americanus* Cushman (1918) from the Culebra formation of the Panama Canal Zone. In order to make the difference clear a photographic illustration is here given of the margin of a specimen selected from the original type lot of specimens (pl. 41, fig. 5). There are at least four rows of apertures and the apertural zone extends over more than one-half, about ⅝ of the peripheral surface of the test.

Another species of *Amphisorus* common in American Miocene deposits in Anguilla and the Chipola formation of Florida has two rows of apertures in the apertural zone. It may be referable to *Amphisorus duplex* (Carpenter). There is in the Tampa formation of Florida a species with three apertural rows in fully developed specimens but there seem to be differences from *A. matleyi*. There is still another form in the La Cruz marl at Santiago, Cuba. Judging from the material in my hands at present, it seems that there are at least five species of *Amphisorus* in the American upper Oligocene and Miocene. It is my intention to consider all of them in a paper which is almost ready for the press. Forms such as *A. americanus* have suggestive similarity to *Marginopora*.

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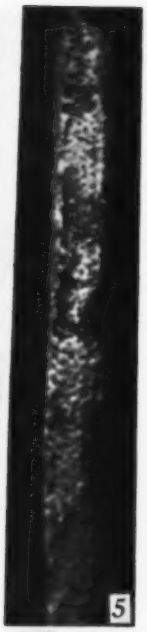
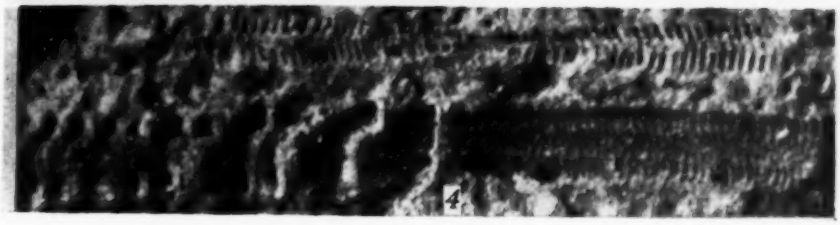
EXPLANATION OF PLATE 41

FIGS. 1–4.—*Amphisorus matleyi* Vaughan, n. sp. Fig. 1, surface of cotype, ×8¾. Fig. 2, marginal apertures of a cotype, ×17½. Specimens from locality J. 313 M. Figs. 3, 3 *a*, two views of a paratype from J. 321 M.; fig. 3, surface, ×3; fig. 3 *a*, annuli, ×17½. Fig. 4, view of two broken specimens, ×17½, illustrating vertical sections, from locality J. 324 M.

5.—*Amphisorus americanus* (Cushman) Vaughan. Marginal apertures, ×17½, of a topotype, from U. S. G. S. locality 6019*b*, lower part of Culebra formation, Gaillard Cut, Panama Canal Zone.





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THE CLAIBORNE FORMATION ON THE COASTAL DOMES

LAURA LANE WEINZIERL and ESTHER R. APPLIN

The Claiborne is, so far, the oldest formation which has been reached by the drill on any Gulf Coastal Dome. It is generally located immediately adjacent to the salt mass from which the beds apparently dip away at a very sharp angle. No well has passed completely through it, although some have been drilled in Claiborne materials for over 800 feet. Hull, Humble, South Liberty, Sour Lake, Palagana, Piedras Pintos, Brenam and Gay Hill are the only Domes from which this formation has yet been recognized and reported.

The Paleontology, as well as the structural relationships of this phase of the Eocene, is intensely interesting. A comparison of faunas found in the well sections with those found in outcropping beds has led the authors to include in this study a brief discussion of its possible depositional conditions, time, and geographical relationships.

Lithologically, the Claiborne of the Domes consists of extremely fine grained brown and gray sandstones, and very fine textured tough black shales which leave an extremely small washed residue of pyrite, sand and occasionally, a little glauconite. The material is usually highly oil stained.

Materials now referred to this formation were first studied from John Dearing's Bissonette No. 1 drilled north of the Humble field, Harris County, Texas. Samples from 3,900—4,165 ft. in this well were submitted to the Rio Bravo Oil Co. laboratory in June, 1921, by Mr. Lee Hager, and on the basis of the large fossils present, were doubtfully determined as Jackson in age. This mistake was chiefly due to the facts that many of the large fossils present were forms which occurred in both the Jackson and Claiborne deposits, that the remaining species were mainly Jackson in character, and that the entire fauna differed to a marked degree from the typical Lower Claiborne

micro-fauna with which the writers were very well acquainted. Later, it was learned that this fauna most closely resembled one which can be secured from a locality one-fourth mile below Robinson's Ferry on the Texas side of the Sabine River in Sabine County. These beds are stratigraphically near the top of the Yegua formation. Several barrels of this material, which is highly fossiliferous, were sent at one time by Alexander Deussen to the U. S. Geological Survey and determined by Drs. Dall and Vaughan to be Upper Claiborne, Eocene in age[1].

Because of this fact, and because we have also found that the micro-faunas present in the Middle Eocene samples from Coastal wells seem to have their closest relationships with micro-faunas secured from outcropping beds, which were called Yegua by Dr. Dumble and Mr. Deussen, we believe that the expression of the Claiborne formation which has been found on the Coastal Domes is Yegua (Upper Claiborne) in age.

In May, 1926, the late Dr. E. T. Dumble sent Miss Grace Newman, Paleontologist, and Mr. Lyman C. Reed, Geologist of the Rio Bravo Oil Co., to collect from the type locality of the Yegua on Elm Creek in Lee County. They also collected from beds assigned to the Yegua by Dr. Deussen, west of Cost, and north of Nixon in Gonzales County, Texas. These samples were used as a basis for comparison between the south Texas faunas and the group of related faunas found in outcropping beds which have been called Cook Mt. or Mt. Selman (Lower Claiborne) by Dr. Dumble and others. In this connection we regret to state that the fauna described from the type localities of the Yegua by Miss Stadnichenko[2] differs so markedly from those secured by Miss Newman and Mr. Reed both in the character of the preservation and in the species present, that we are unable to correlate her forms with those which were collected from Dumble's type locality, but feel obliged to refer her collection to the Cook Mt. As stated in Dumble's[3] "Geology of East Texas" the stream on which the type locality is found cuts alternately into the Cook Mt. and Yegua formations.

The Middle Eocene faunas of the Domes, although showing a natural similarity in their general aspect to the prolific and wide spread Lower Claiborne Texas outcropping faunas, show also certain constant differences which may be seen also in the few highly fossiliferous outcrop samples of the Yegua mentioned above. The

[1] Private Communications of Mr. Deussen.
[2] Journal of Paleontology, vol. 1, no. 3, pp. 221-243, 1927.
[3] Geology of East Texas, Univ. of Texas Bulletin, 1869, 1918, p. 102.

range of each species will be indicated in relation to the above mentioned comparisons and the many marked differences will be noted under the discussion of the forms.

So far we have only indicated a similarity between the South-Texas buried deposits and the more northern outcropping beds, but the Domal faunas show also an interesting relationship with the Eocene of the more southern outcrop deposits of Mexico and Trinidad. This relationship, also will be indicated under the discussion of species.

It has been our good fortune to study well sections cutting through Middle Eocene materials from such widely separated areas as east Texas (Hansen No. 1, Jasper County), southwestern Texas (Fant Ranch well, Live Oak County), and northern Mexico (Nationales No. 201) in addition to the Dome sections already referred to. The information thus secured, added to that which was to be found in a study of the outcropping sections named in the locality list, has formed the basis of the following suggestions regarding the history of the Yegua deposits in Texas.

At the beginning of Yegua times the sea was, apparently much shallower, probably more brackish and much more limited in extent than during the major portion of the Cook Mt. period. After a very brief time it retreated rapidly leaving a series of swamps and lagoons in which the deposits of the typical Yegua were laid down. Apparently the line of demarkation between the two types of deposits, marine and lagoonal, was not drawn at exactly the same time along the entire sea front, but was more or less irregular on the east, and as the Rio Grande was nearer, the marine conditions continued much longer and in places alternated with the lagoonal. In the far eastern area, from which we have a few well records and in the southwest, there is evidence of a number of very shallow brief incursions of the sea, shown by the occasional appearance of a small fauna of shallow water forms at irregular intervals in the Yegua sections. Just south of the Rio Grande in Mexico a well (Nationales No. 201) has been drilled for over 3,000 ft. in continuous marine deposits. In the extreme eastern portions of the State, there was, as indicated by the deposits found one-fourth mile below Robinson's Ferry, Sabine County, a return of fairly deep water marine conditions at or very near the end of the Yegua times. It seems reasonable to suppose also that in the South Texas Domal area, the sea, as in northern Mexico, probably covered the area during the greater portion of the Yegua period. Our conception of the Paleontology of

the Yegua, therefore, is of a transitional period, into which some of the more resistant species from the Cook Mt. continued with such varietal changes as the changing conditions would induce, and in which also we find introduced a number of new forms, a few of which, having existed during this comparatively difficult time, lived on and expanded in numbers and varieties in the more favorable period of the Upper Eocene which followed. The fauna looks backward toward the Cook Mt. in its early phases, and forward, toward the Jackson in its final expression, in areas in which the marine conditions were largely confined to the beginning and the end of the period; but in south Texas and in northern Mexico where the deposition was almost entirely marine, the appearance of the fauna is more decidedly Lower Claiborne throughout. However, new species, and some more southern forms were introduced and many of the common Claiborne forms are missing, which gives to even the most backward appearing of the Yegua faunas a distinctive, characteristic appearance of their own.

We gratefully acknowledge our indebtedness to the late Dr. E. T. Dumble, Mr. Alexander Deussen, Miss Grace Newman and to the Geological Departments of the Humble, Texas and Rio Bravo Oil Companies, whose valuable assistance and co-operation made this paper possible. We wish to acknowledge the very great service rendered by Mrs. Helen Jeanne Plummer, who not only made the illustrations accompanying this report, but permitted the free use of her valuable library and gave most liberally of her time and advice during the formative period of the work.

LIST OF LOCALITIES

1. John Deering Well, Bissonett No. 1, near Humble, Harris Co., Texas.
2. John Deering Well, Bissonett No. 2, near Humble, Harris Co., Texas.
3. Humble Oil Co. Well, Wilson No. 1, Hull Field, Liberty Co., Texas.
4. Humble Oil Co. Well, Guedry No. 17, Hull Field, Liberty Co., Texas.
5. Humble Oil Co. Well, Pickett 3C, Liberty Field, Liberty Co., Texas.
6. Rio Bravo Oil Co., Deussen B 1, S. Liberty Field, Liberty Co., Texas.
7. Peer Oil Co., Hamilton No. 1, S. Liberty Field, Liberty Co., Texas.
8. Thomas Oil Co., Bender Adams No. 2, Humble Field, Harris Co., Texas.
9. Texas Co., Bender Adams No. 4, Humble Field, Harris Co., Texas.
10. Humble Oil Co., Bashara No. 19, Sour Lake Field, Hardin Co., Texas.
11. Humble Oil Co., Walsh No. 5, Pedros Pintos Field, Duval Co., Texas.
12. Applin & Reed, Sec. 1, No. 2, Atascosa Co. Section, about 1 mile north of McCoy Station, McCoy Ranch, west bank of the river, Atascosa Co., Texas.
13. Newman & Reed, Loc. No. 63, about 300 yds. north of Cost on the Monthalia Road, Gonzales Co., Texas.

14. Newman & Reed, Loc. No. 81, one mile west of Cost, on Leesville Road, a little north of the road, Gonzales Co., Texas.
15. Newman & Reed, Loc. No. 3, Price's Crossing on Elm Creek, Lee Co., Texas.
16. Applin & Reed, Loc. No. 28, north of Nixon, Gonzales Co., Texas.
17. Newman & Reed, Loc. No. 1, No. 2, one mile west up the Creek from the point where Giddings-Mannheim Road crosses Elm Creek, Lee Co., Texas.
18. Newman & Reed, Loc. No. 2, about one-half mile north of Cost, on the Monthalia Road, Gonzales Co., Texas.
19. Newman & Reed, Sec. No. 2, Elm Creek at Grills Crossing, Lee Co., Texas.
20. P. L. & E. R. Applin, Loc. one-quarter mile below Robinson's Ferry, on the Sabine River, at the River's edge, Sabine Co., Texas.
21. Yegua outcrop, four-tenths of a mile, east of the Main Plaza, Dr. Cos. Neuva Leon, Mexico.
22. Nationales No. 201, Tamaulipas, Mexico.
23. Hansen No. 1, East Texas Oil Co., Angelina Co., Texas.
24. Demonstration Farm Well, Fant Ranch, Live Oak Co., Texas.
25. Humble & Frontier Pet. Co. Well, Camargo No. 1, Tamaulipas, Mexico.

LIST OF SPECIES

Ammodiscus incertus (d'Orbigny)
Haplophragmoides excavata Cushman and Waters, var.
Ammobaculites cf. *foliaceus* (H. B. Brady)
Textularia claibornensis, n. sp.
Textularia carinata (d'Orbigny), var.
Verneuilina cushmani, n. sp.
Clavulina communis d'Orbigny
Quinqueloculina yeguaensis, n. sp.
Triloculina trigonula (Lamarck)
Robulus gyroscalprum (Stache)
Robulus mexicana (Cushman), var. *deusseni*, n. var.
Robulus papillosa (Fichtel and Moll), var.
Robulus dumblei, n. sp.
Lenticulina rotulata Lamarck
Lenticulina torrida (Cushman)
Dentalina multilineata Bornemann
Dentalina cf. *spinulosa* (Montagu)
Nodosaria kressenbergensis Gümbel
Nodosaria mexicana Cushman
Nodosaria ewaldi Reuss
Globulina gibba d'Orbigny
Sigmomorpha (Sigmomorphina) pseudoregularis Cushman and Thomas
Nonion micrus Cole
Nonion umbilicatulus (Montagu), var.
Nonion scapha (Fichtel and Moll)
Plectofrondicularia mexicana (Cushman), var. *plummerae*, n. var.
Hantkenina dumblei, n. sp.
Bulimina cf. *inflata* Seguenza
Bulimina bradyi, n. sp.
Uvigerina pygmaea d'Orbigny
Uvigerina pygmaea d'Orbigny, var. *yeguaensis*, n. var.
Discorbis yeguaensis, n. sp.
Lamarckina marylandica Cushman, var. *yeguaensis* Cushman
Gyroidina soldanii d'Orbigny, var. *octocamerata* Cushman and G. D. Hanna
Gyroidina guayabalensis Cole
Eponides guayabalensis Cole, var. *yeguaensis*, n. var.
Epistomina eocenica Cushman and M. A. Hanna
Siphonina tenuicarinata Cushman
Ceratobulimina eximia (Rzehak), var.
Globigerina inflata d'Orbigny
Globigerina yeguaensis, n. sp.
Globorotalia crassata (Cushman)
Anomalina costiana, n. sp.
Anomalina umbonata Cushman
Cibicides deusseni, n. sp.

DESCRIPTION OF SPECIES

Subkingdom PROTOZOA

Order FORAMINIFERA

Family AMMODISCIDAE

Subfamily AMMODISCINAE

Genus AMMODISCUS Reuss, 1861

AMMODISCUS INCERTUS (d'Orbigny)

Operculina incertus (D'ORBIGNY), Forams. Cuba, p. 71, pl. 6, figs. 16, 17, 1839.
Ammodiscus incertus H. B. BRADY, Rept. *Challenger*, Zool., vol. 9, p. 330, pl. 38, figs. 1-3, 1884.

Discussion.—Specimens which we have referred to this species occur, occasionally in the formation.

Family LITUOLIDAE

Subfamily HAPLOPHRAGMIINAE

Genus HAPLOPHRAGMOIDES Cushman, 1910

HAPLOPHRAGMOIDES EXCAVATA Cushman and Waters, var.

Description.—Our variety differs from the species in being less strongly compressed, in having fewer chambers, generally eight in the adult form, and in having only the last three or four chambers excavated and never so clearly, or completely as in the true *Haplophragmoides excavata.* Also the Claiborne form is a heavier, much less delicate species than its Cretaceous relative.

Occurrence.—This variety is found in a number of horizons in the Yegua formation, its occurrence being apparently governed by the presence or absence of certain favorable depositional conditions. It occurs also, in the Lower Claiborne, Cook Mt. formation.

Holotype.—John Deering, Bissonett No. 2, 4,015 ft., Humble Field, Harris Co., Texas.

CHECK LIST OF SPECIES—CLAIBORNE FORMATION ON COASTAL DOMES

L. L. Weinzierl and E. R. Applin

LIST OF SPECIES	LOCALITIES																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Ammodiscus incertus (d'Orbigny)		R	R			R												R			C			C	
Haplophragmoides excavata Cushman and Waters, var.	R	C		C	R	C	C			R					C		A						R		R
Ammobaculites cf. foliaceus (H. B. Brady)																							C	C	C
Textularia claibornensis, n. sp.	A	A		C	R	C	R		C	C			R		R	R		C		C		C		C	C
Textularia carinata (d'Orbigny), var.	R	C		A	A	R	C	R	R	C	C			C				R			R	C	C		C
Verneuilina cushmani, n sp.	R	C				A	C	R		R					C		A		C						
Clavulina communis d'Orbigny		R			C	R	R																		
Quinqueloculina yeguaensis, n sp.	C	C		C			R		R		C		C		R	C		R		C	C	R	R		R
Triloculina trigonula (Lamarck)						C					C		C					R				R			
Robulus gyroscalprum (Stache)			R			C																			
Robulus mexicanus (Cushman), var. deusseni, n. var.		R	R		R	C	A	A	A		C		R	C	R			C	C		R	R	R		
Robulus papillosus (Fichtel and Moll), var.	R					C																			
Robulus dumblei, n. sp.						R	R		R	R												R			
Lenticulina rotulata Lamarck	R	R	C		R	C		C	R	R	A	C	C		C	C		R	R		C	C	R	C	C
Lenticulina torrida (Cushman)						R																			
Dentalina multilineata Bornemann						R																			
Dentalina cf. spinulosa (Montagu)						R																			
Nodosaria kressenbergensis Gümbel						C				R															
Nodosaria mexicana Cushman		R		R	C			C		A	C		R								C	C	C		R
Globulina gibba d'Orbigny	R	C					R						R		C	R		R	C						
Sigmomorpha (Sigmomorphina) pseudo-regularis Cushman and Thomas								R					R		R	R		R							
Nonion micrus Cole			R			C	R																		
Nonion umbilicatulus (Montagu)		C	R	R		R				R			C	A	A				R		C				C
Nonion scapha (Fichtel and Moll)		R													R					C			R		
Plectofrondicularia mexicana (Cushman), var. plummerae, n. var.						C																			
Hantkenina dumblei, n. sp.		R	R		R	C																			
Bulimina cf. inflata Seguenza						C																			
Bulimina bradyi, n. sp.			R		R	R																			
Uvigerina pygmaea d'Orbigny	R	R	C		R	C				C													C		R
Uvigerina pygmaea d'Orbigny, var. yeguaensis, n. var.					R	C	R																R		
Discorbis yeguaensis, n. sp.							R				R		R		A	A				C			R		

Lamarkina marylandica, var. yeguaensis Cushman																C						C				
Gyroidina soldanii d'Orbigny, var. octocamerata Cushman and Hanna	R	R	C	R	R	R		C		R			R		C	A		R	C						C
Gyroidina guayabalensis Cole				R																		R				
Eponides guayabalensis Cole, var. yeguaensis, n. var.	C	A	R	A	A	C	C	A	C	A			A	C	C	A		C	A		A	A			C
Epistomina eocenica Cushman and Hanna						R							A													
Siphonina tenuicarinata Cushman		C		A	C	R		C	C	C			C		A	C		C	C	A	A		C		C
Ceratobulimina eximia (Rzehak), var.					R	R			C						C	R		C								
Globigerina inflata d'Orbigny		C	C	R	C	C	R		R	R			R										R			
Globigerina yeguaensis, n. sp.		R	C	R		C	R		R	R			R						R			R				
Globorotalia crassata (Cushman)			C		R	R	R	R	R				R					R	R							
Anomalina costiana, n. sp.				R	R					R	C	A	A	A	R	C		C	R		R					
Anomalina umbonata Cushman		C	R	R	C	C	C	R	R		C			R									R			
Cibicides deusseni, n sp.		R			R	C																				

A — Abundant
C — Common
R — Rare

Genus AMMOBACULITES Cushman, 1910

AMMOBACULITES cf. FOLIACEUS (H. B. Brady)

Haplophragmium foliaceum H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, p. 50, 1881.

Ammobaculites foliaceus CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 1, figs. 177-179, 1910.

Discussion.—Specimens which we have referred to this species occur in the more sparsely fossiliferous horizons of the Yegua, and are often the major element in the meager faunas of the middle Yegua horizons in eastern and southwestern Texas.

Family TEXTULARIIDAE

Subfamily TEXTULARIINAE

Genus TEXTULARIA Defrance, 1824

TEXTULARIA CLAIBORNENSIS, n. sp.

Plate 44, figs. 1 *a*, *b*

Description.—Form long and narrow, somewhat compressed, chambers numerous, in the earlier portion and for about two-thirds of the length of the mature form, very low and broad, in the remainder portion higher, averaging twice the height of the earlier chambers, and more inflated; periphery sub-acute; sutures vague in the initial portion of the test, distinct and somewhat depressed in the last few divisions; walls of smooth texture, very finely arenaceous; aperture a broad, rounded rectangular opening in the central portion of the base of the apertural face of the last formed chamber.

Occurrence.—This species is very common in the more sandy phases of the Domal Yegua.

Cotypes.—(Cushman Coll. No. 12199) John Deering, Bissonett No. 2, 4,015 ft., Humble, Harris Co., Texas.

TEXTULARIA CARINATA (d'Orbigny), var.

Discussion.—The Claiborne form closely resembles the species as it is figured in the Vienna Monograph[4]. It lacks the spines generally associated with the type, and is more broadly triangular in outline than the typical *T. carinata*. It is broader and heavier than either the Midway or the Oligocene characteristic forms.

[4] Foram. Foss. Vienne, pl. 14, figs. 32-34, 1846.

Occurrence.—The variety is common throughout the Claiborne (Upper and Lower) in Texas, but is usually not abundant in any portion of the formation.

Family VERNEUILINIDAE

Genus VERNEUILINA d'Orbigny, 1840

VERNEUILINA CUSHMANI, n. sp.

Plate 42, figs. 4 *a*, *b*

Description.—Test small, triserial, pyramidal in outline, apical end bluntly rounded, chambers compressed, walls white, finely arenaceous; aperture, an elongated slit, sometimes bordered with a lip, at the base of the inner margin of the last chamber.

Occurrence.—This species occurs throughout the Claiborne in Texas, but is more abundant in some phases of the sub-surface Yegua than in any of the Lower Claiborne horizons of which we are aware.

Cotypes.—(Cushman Coll. No. 12200) Rio Bravo Oil Co., Deussen B 1 well at South Liberty, Hardin Co., Texas.

Genus CLAVULINA d'Orbigny, 1826

CLAVULINA COMMUNIS d'Orbigny

Clavulina communis D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 268, 1826.

Discussion.—A few specimens of this form occur occasionally in the phases of the Yegua formation found on the South Texas Domes.

Family MILIOLIDAE

Genus QUINQUELOCULINA d'Orbigny, 1826

QUINQUELOCULINA YEGUAENSIS, n. sp.

Plate 44, figs. 4 *a*, *b*

Quinqueloculina seminulum (STAFNICHENKO), Journ. Pal., vol. 1, no. 3, pp. 226-227, pl. 38, fig. 28, 1927.

Description.—Shell smooth, slightly compressed, oval in outline, peripheral chambers nearly cylindrical, aperture containing an anvil shaped tooth, in the short necklike extension of the final chamber.

In general outline and arrangement of chambers this form closely resembles the figures and descriptions of *Q. seminulum* (Linnaeus), as restricted by Cushman[5], but differs from that form in always having the apertural end exserted.

Occurrence.—This species is found in both Upper and Lower Claiborne beds of Texas.

Cotypes.—(Cushman Coll. No. 12201) Outcrop about 300 yards north of Cost on the Monthalia Road, Gonzales Co., Texas.

[5] Bull. 71, U. S. Nat. Mus., pt. 6, p. 44, pl. 11, fig. 2 a-b, 1917.

Genus TRILOCULINA d'Orbigny, 1826

TRILOCULINA TRIGONULA (Lamarck)

Miliolites trigonula LAMARCK, Ann. Mus., vol. 5, p. 351, no. 3, 1804.
Triloculina trigonula D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 299, no. 1, pl. 16, figs. 5-9, 1826.

Discussion.—This species, although not abundant, occurs occasionally in both the Upper and the Lower Claiborne, and is usually a common form in the facies in which it appears.

Family LAGENIDAE

Subfamily NODOSARIINAE

Genus ROBULUS Montfort, 1808

ROBULUS GYROSCALPRUM (Stache)

Cristellaria gyroscalprum STACHE, Foram., der Tert, Mergel de Whaingaroa—Hafens, p. 245, pl. 23, figs. 22 *a*, *b*, 1864.
Cristellaria gyroscalprum CHAPMAN, Geol. Surv. New Zealand, Pal. Bull., no. 11, p. 62, pl. 4, figs. 21 *a*, *b*, 22 *a*, *b*, 24 *a*, *b*, 1926.

Discussion.—Our species is not a large form like that described by Chapman from New Zealand, but it is identical with some found in the London Clay, as also mentioned by Chapman.

Occurrence.—This species is rare in the Yegua formation.

ROBULUS MEXICANA (Cushman), var. DEUSSENI, n. var.
Plate 44, figs. 8 *a*, *b*

Description.—This form is apparently closely allied to the species described by Cushman from the Eocene of the Moctezuma River, Mexico[6], and since reported from other Mexican outcrops. The va-

[6] Bull. Amer. Assoc. Petrol. Geol., vol. 9, no. 2, p. 299, pl. 7, figs. 1, 2, 1925.

EXPLANATION OF PLATE 42

FIGS. 1 *a–c.*—*Eponides guayabalensis* Cole. ×100. *a*, Dorsal view; *b*, ventral view; *c*, apertural view. Typical Lower Claiborne form.

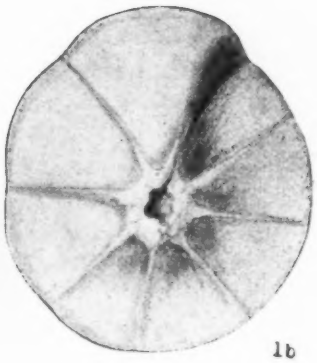
2 *a–c.*—*Eponides guayabalensis* Cole, var. *yeguaensis*, n. var. ×100. *a*, Dorsal view; *b*, ventral view; *c*, apertural view. Typical Yegua form.

3 *a, b.*—*Ceratobulimina eximia* (Rzehak), var. ×100. *a*, Dorsal view; *b*, ventral view. A Yegua specimen.

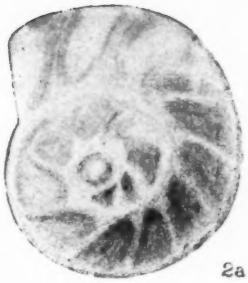
4 *a, b.*—*Verneuilina cushmani*, n. sp. *a*, Front view; *b*, back view, showing aperture.

1a

1c

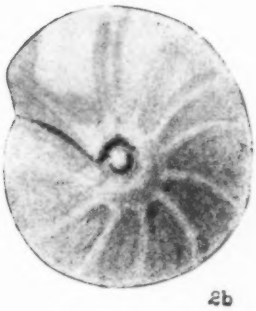


1b



2a

2c

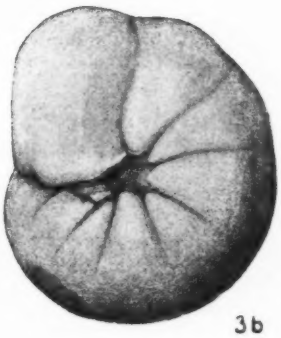


2b

4a

3a

4b



3b

MICH.

riety differs from the species mainly in the character of the ornamentation. Long drop-like beads of fairly uniform size outline each suture both on the coiled and uncoiled portions of the test. The keel is also less pronounced, and the mature form generally broader and more compressed in the uncoiled section than in the type. The true species is present in large numbers in the Cook Mt. and in phases of the Lower Claiborne of Louisiana.

Occurrence.—The variety is common in the Yegua formation and abundant in some of the sub-surface horizons of south Texas.

Cotypes.—(Cushman Coll. No. 12202) Rio Bravo Oil Co. well, Deussen B 1, South Liberty Dome, Liberty Co., Texas. Core 3,736 ft.

ROBULUS PAPILLOSA (Fichtel and Moll), var.
Plate 44, fig. 6

Nautilus papillosus FICHTEL and MOLL, Test. Micr., p. 82, pl. 14, figs. *a-c*, 1803.

Discussion.—We find this very beautiful species in samples from some of the wells drilled into the Yegua on the Gulf Coast. In the variety, the beads near the umbo have developed into conical protuberances, or even short spines, but near the periphery the sutures are covered by a limbate ridge showing only a slight tendency toward beading. The margin it outlined by a narrow phlange.

Occurrence.—Found only in the Yegua in the area of the Coastal Domes.

ROBULUS DUMBLEI, n. sp.
Plate 43, figs. 3 *a*, *b*

Description.—This species is probably a member of the *Cristellaria rotulata* group, but is easily recognized by the unusual character of the sutural ornamentation. The form is close coiled, strongly biconvex; chambers numerous, ten generally visible in the mature forms; umbo covered by a thick boss of clear shell material; sutures outlined by low ribs which are very narrow near the umbo, and close to the periphery, but widen rapidly in the area between these two points. The margin is outlined by a very thick and narrow keel.

Occurrence.—This interesting species is also found in the Coastal Eocene horizon.

Holotype.—(Cushman Coll. No. 12203) Rio Bravo Oil Co. well, Deussen B 1, 4,010 ft., South Liberty Dome, Hardin Co., Texas.

Genus LENTICULINA Lamarck, 1804

LENTICULINA ROTULATA Lamarck

"Cornu Hammonis seu Nautili" Plancus, Conch. min., p. 13, pl. 1, fig. 3, 1739.
Lenticulites rotulata LAMARCK, Ann. Mus., vol. 5, p. 188, no. 3, 1804.
(*Not Cristellaria rotulata* CARSEY), Univ. Tex. Bull., no. 2612, p. 39, pl. 6, fig. 2, 1926.
Cristellaria rotulata STADNICHENKO, Journ. Pal., vol. 1, no. 3, p. 228, pl. 38, figs. 12, 13, 29, 1927.

Discussion.—This is a very common species throughout both the Yegua and the Cook Mountain. As indicated in the synonymy, the Eocene specimens are clearly distinct from the Cretaceous form which has been listed as the same species by Mrs. Carsey. The Cretaceous form is more elliptical in outline since it is not so closely coiled, and has fewer chambers.

LENTICULINA TORRIDA (Cushman)

Cristellaria torrida CUSHMAN, U. S. Mus. Bull. 104, pt. 4, p. 105, pl. 25, 1923.

Discussion.—Very rare, but found occasionally in both the Upper and the Lower Claiborne of Texas.

Genus DENTALINA d'Orbigny, 1826

DENTALINA MULTILINEATA Bornemann

Dentalina multilineata BORNEMANN, Zeitschr. deutsch. Geol. Ges., vol. 7, p. 325, pl. 13, fig. 12, 1855.

Discussion.—Many fragments of a form which we believe we are correctly referring to this species occur in Yegua samples taken from wells on the Gulf Coast. It is a very fragile species and we are not so fortunate as to secure a perfect specimen.

Occurrence.—Upper Claiborne on the Domes. Cushman reports this species from the Alazan of Mexico.

DENTALINA cf. SPINULOSA (Montagu)

Nautilus spinulosus MONTAGU, Test Brit., Suppl., p. 86, pl. 19, 1808.
Dentalina spinulosa SHERBORN and CHAPMAN, Journ. Roy. Micr. Soc., ser. 2, vol. 4, p. 751, pl. 15, fig. 13, 1886.
Dentalina spinulosa FRANKE, Danmarks geologiske Undersogela, 2, Raekke M. 46, p. 15, pl. 1, fig. 20, 1927.

Discussion.—Fragments of a form which we are referring to this species are also common in the Domal Yegua.

Genus NODOSARIA Lamarck, 1812

NODOSARIA MEXICANA Cushman

Nodosaria mexicana CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 1, pt. 1, p. 5, pl. 1, figs. 3, 4, 1925.

Discussion.—This is one of the most widely distributed, and best preserved of the species of *Nodosaria* common in the Yegua formation. Many complete specimens from a number of localities were secured.

Occurrence.—Found in both the Upper and the Lower Claiborne beds of Texas. Reported also from several phases of the Eocene of Mexico.

NODOSARIA KRESSENBERGENSIS Gümbel

Plate 43, fig. 2

Nodosaria kressenbergensis GÜMBEL, Abhandl. bay. Akad. Wiss., vol. 10, p. 609, pl. 1, fig. 12, 1868.

Discussion.—This beautiful species is abundant in some phases of the Yegua found in the Texas coastal wells. It differs from *Nodosaria soluta* (Reuss), to which it is most closely related, mainly in being a very delicate, gradually tapering form, and in having the chambers united to one another with slender necks. We figure it here, because the original figure is found in a publication not generally available to many American workers.

Occurrence.—Material from coastal domes.

Plesiotype.—(Cushman Coll. No. 12214) Rio Bravo Oil Co., Deussen B 1, 4,010 ft., South Liberty Dome, Liberty Co., Texas.

EXPLANATION OF PLATE 43

FIGS. 1 *a, b.*—*Globigerina yeguaensis*, n. sp. ×100. *a*, Dorsal view; *b*, ventral view.

2.—*Nodosaria kressenbergensis* Gümbel. ×100.

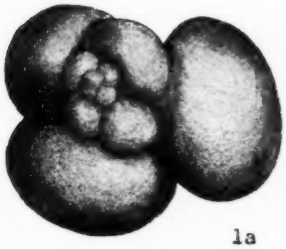
3 *a, b.*—*Robulus dumblei*, n. sp. ×100. *a*, Side view; *b*, front view.

4.—*Sigmomorpha (Sigmomorphina) pseudoregularis* Cushman and Thomas. ×100.

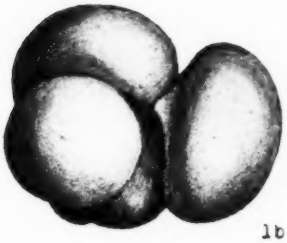
5 *a, b.*—*Hantkenina dumblei*, n. sp. ×100. *a*, Young specimen; *b*, more mature form.

6 *a–c.*—*Nonion micrus* Cole. ×100. *a, b*, Opposite sides; *c*, apertural view.

7.—*Bulimina bradyi*, n. sp. ×100.

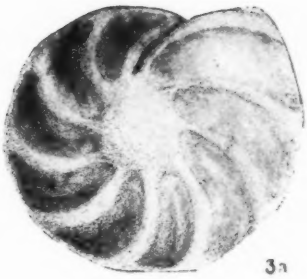


1a



1b

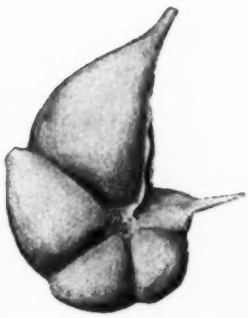
2



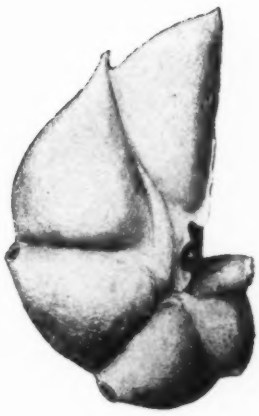
3a

3b

4



5a



5b

6a

6c

6b

7

UNIV. OF MICH.

NODOSARIA EWALDI Reuss

Nodosaria ewaldi REUSS, Zeitschr. deutsch. geol. Ges., vol. 3, p. 58, pl. 3, fig. 2, 1851.

Nodosaria ewaldi CUSHMAN, Journ. Pal., vol. 1, no. 2, p. 153, pl. 24, figs. 1, 2, 1927.

Discussion.—Fragments of this species are common in sections of the Yegua formation drilled into near the Domes.

Family POLYMORPHINIDAE

Genus GUTTULINA d'Orbigny, 1826

Subgenus GLOBULINA d'Orbigny

GLOBULINA GIBBA d'Orbigny

Globulina gibba D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 267, 1826.

Occurrence.—This species is common, though never abundant, throughout both the Upper and the Lower Claiborne formations in Texas.

Genus SIGMOMORPHA Cushman and Ozawa, 1928

SIGMOMORPHA (SIGMOMORPHINA) PSEUDOREGULARIS Cushman and Thomas

Plate 43, fig. 4

Sigmomorpha (Sigmomorphina) pseudoregularis CUSHMAN and THOMAS, Journ. Pal., vol. 3, no. 2, p. 178, pl. 23, figs. 5 *a-c*, 1929.

Occurrence.—This very interesting and distinctive species is found in the Lower Claiborne, and in some basal phases of the Yegua at the outcrop. It has not yet been reported from higher phases of the Yegua formation.

Plesiotype.—(Cushman Coll. No. 12215) About 300 yards north of Cost, on the Monthalia Road, Gonzales Co., Texas.

Family NONIONIDAE

Genus NONION Montfort, 1808

NONION MICRUS Cole

Plate 43, figs. 6 *a-c*

Nonion micrus COLE, Bull. Amer. Pal., vol. 14, no. 51, p. 22, pl. 5, fig. 12, 1927.

Discussion.—A form which we believe to be the same as the species described by Cole from the Chapote and Guayabal of Mexico is abundant in a facies of the Yegua found on the Coastal Domes.

Occurrence.—This species occurs in no other Texas formation of which we are aware.

Plesiotype.—(Cushman Coll. No. 12216) Rio Bravo Oil Co., Deussen B 1 well, 4,010 ft., South Liberty Domes, Liberty Co., Texas.

NONION UMBILICATULUS (Montagu), var.

Nautilus umbilicatulus MONTAGU, Test. Brit., p. 191, 1803.
Nonionina umbilicatula PARKER, JONES and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 4, vol. 8, p. 242, pl. 12, fig. 157, 1871.

Occurrence.—A variety of this species occurs occasionally in the Yegua, and is very common in Lower Claiborne beds. It is reported by Cole from the Guayabal of Mexico.

NONION SCAPHA (Fichtel and Moll)

Nautilus scapha FICHTEL and MOLL, Test. Micr., p. 105, pl. 19, figs. *d-f*, 1803.
Nonionina scapha PARKER and JONES, Ann. Mag. Nat. Hist., ser. 3, vol. 5, p. 102, no. 4, 1860.

Occurrence.—A few specimens of a form which may be loosely referred to this species are occasionally found in both Upper and Lower Claiborne beds. Species which may be said to belong to the *Nonion scapha* group, are common in the Jackson, and become dominant, and therefore highly important forms in the Marine Oligocene formation of Texas.

Family HETEROHELICIDAE

Subfamily PLECTOFRONDICULARINAE

Genus PLECTOFRONDICULARIA Leibus, 1903

PLECTOFRONDICULARIA MEXICANA (Cushman), var. PLUMMERAE, n. var.
Plate 44, fig. 3

Discussion.—Cushman has already indicated the varietal characteristics of this form[7], which we will copy here:

"The Claiborne form is slightly more slender than the Mexican or Trinidad specimens and there is more of a tendency to taper toward the apertural end. The last formed chambers in the Claiborne form are also somewhat higher."

Occurrence.—Numerous specimens of this variety are found in a facies of the Domal Yegua of the Gulf Coast of Texas.

Holotype.—(Cushman Coll. No. 12205) Rio Bravo Oil Co., Deussen B 1, 4,010 ft., South Liberty Dome, Liberty Co., Texas.

[7] Contr. Cushman Lab. Foram. Res., vol. 2, pt. 2, p. 39, 1926.

Family HANTKENINIDAE

Genus HANTKENINA Cushman, 1924

HANTKENINA DUMBLEI, n. sp.

Plate 43, figs. 5 *a*, *b*

Description.—Test planispiral, much compressed, roughly elliptical in outline; sutures distinct, strongly depressed; chambers slightly lobulate, increasing very rapidly in size and height, usually six in the adult coil; walls very finely punctate.

Form most similar to *Hantkenina longispina* Cushman, but with the latter chambers even more elongated, and the spines shorter and more slender. Early chambers not visible.

Occurrence.—Subsurface Yegua of the Texas Gulf Coast.

Cotypes.—(Cushman Coll. No. 12204) Rio Bravo Oil Co., Deussen B 1, 4,010 ft., South Liberty Dome, Liberty Co., Texas.

Family BULIMINIDAE

Subfamily TURRILININAE

Genus BULIMINA d'Orbigny, 1826

BULIMINA cf. INFLATA Seguenza

Bulimina inflata SEGUENZA, Atti Acad. Gioenia Sci. Nat., ser. 2, vol. 18, p. 109, pl. 1, fig. 10, 1862.

Occurrence.—A few specimens of a form which may be referred

EXPLANATION OF PLATE 44

FIGS. 1 *a*, *b*.—*Textularia claibornensis*, n. sp. ×100. *a*, Front view; *b*, apertural view.

2 *a–c*.—*Cibicides deusseni*, n. sp. ×100. *a*, Ventral view; *b*, dorsal view; *c*, peripheral view.

3.—*Plectofrondicularia mexicana* Cushman, var. *plummerae*, n. var. ×100.

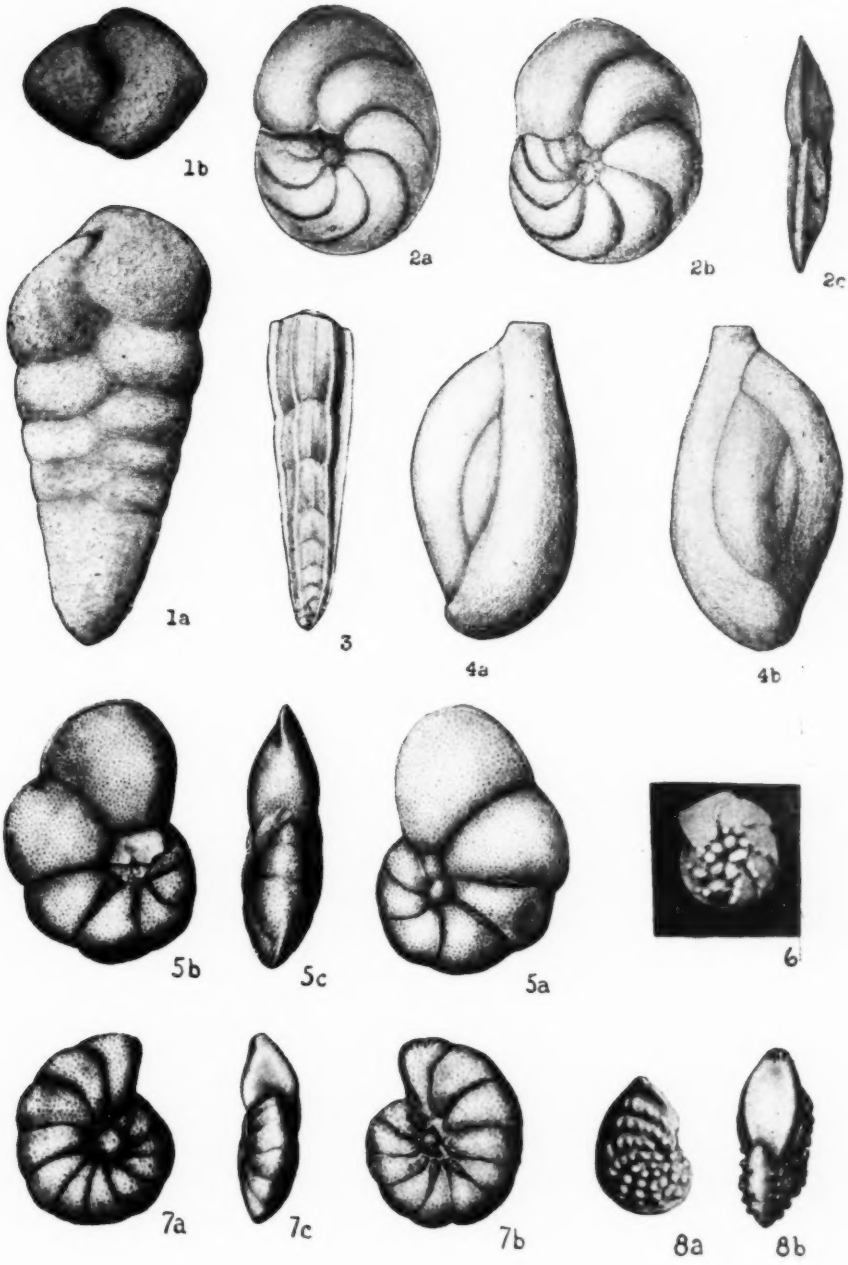
4 *a*, *b*.—*Quinqueloculina yeguaensis*, n. sp. ×100. *a*, *b*, Opposite sides.

5 *a–c*.—*Discorbis yeguaensis*, n. sp. ×65. *a*, Dorsal view; *b*, ventral view.

6.—*Robulus papillosa* (Fichtel and Moll), var.

7 *a–c*.—*Anomalina costiana*, n. sp. ×65. *a*, Dorsal view; *b*, ventral view; *c*, peripheral view.

8 *a*, *b*.—*Robulus mexicana* Cushman, var. *deusseni*, n. var. ×50. *a*, Side view; *b*, apertural view.


1b
2a
2b
2c
1a
3
4a
4b
5b
5c
5a
6
7a
7c
7b
8a
8b

to Seguenza's species are found in samples of the Yegua material secured from Texas Gulf Coastal Domes.

BULIMINA BRADYI, n. sp.
Plate 43, fig. 7

Description.—This species is very close to one figured by H. B. Brady[8] but does not agree with the original description of the species in which the costae are not continuous over the chambers. Our species is slightly more elongated and narrower than the one figured by Brady. It is most closely related to the species figured by Cushman and Applin as *Bulimina jacksonensis*[9], but differs from that form also, in being a smaller, shorter and more broadly conical species, less well developed than the Jackson form of which it is probably the progenitor.

Occurrence.—Subsurface Yegua of the Gulf Coastal Domes.

Holotype.—(Cushman Coll. No. 12206) Rio Bravo Oil Co., Deussen B 1, 4,010 ft., South Liberty Dome, Liberty Co., Texas.

Subfamily UVIGERININAE

Genus UVIGERINA d'Orbigny, 1826

UVIGERINA PYGMAEA d'Orbigny

Uvigerina pygmaea D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 267, pl. 12, figs. 8-9, 1826.

Occurrence.—Specimens which are very close to some figured by Brady[10], as illustrative of this species are found throughout the Claiborne of Texas.

UVIGERINA PYGMAEA d'Orbigny, var. YEGUAENSIS, n. var.

Description.—So many things have been called *Uvigerina pygmaea,* that it is very difficult to find some means of clearly indicating some of the many distinct forms which have been referred to that species. The form generally thought of as *Uvigerina pygmaea,* is a small, rather stout species, having the chambers ornamented by numerous, moderately slender, longitudinal costae. The species here described is small, rather elongate, fusiform; chambers over the major portion of the test ornamented with short spines which become fused into longitudinal striations, or are arranged in a closely spaced

[8] Rep. Voy. *Challenger*, Zoology, vol. 9, p. 407, pl. 51, figs. 18, 19, 1884.
[9] Bull. Amer. Assoc. Petroleum Geol., vol. 10, no. 2, p. 168, pl. 7, figs. 8 a, b, 1926.
[10] Rep. Voy. *Challenger,* Zoology, vol. 9, pl. 74, figs. 24-26, 1884.

rectilinear series near the initial end. This form is very close to one figured by Brady[11] in the *Challenger* Report, as a phase of *Uvigerina pygmaea.*

Occurrence.—Yegua in well samples taken from Gulf Coast Domes.

Holotype.—(Cushman Coll. No. 12207) Rio Bravo Oil Co., Deussen B 1, 4,010 ft., South Liberty Dome, Liberty Co., Texas.

Family ROTALIIDAE

Subfamily DISCORBISINAE

Genus DISCORBIS Lamarck, 1804

DISCORBIS YEGUAENSIS, n. sp.

Plate 44, figs. 5 *a-c*

Description.—Test roughly oval in outline, compressed unequally biconvex, dorsal side convex, ventral side flattened, peripheral margin thin, carinate, slightly lobulate; chambers few, 7 or 8 visible on either face, increasing in size very rapidly so that the last chamber forms about ⅓ of the surface on the ventral side of the test; walls finely punctate, sutures curved, limbate, slightly depressed; umbilical area open, or sometimes almost covered by a tongue-like projection of clear shell material extending from the base of the final chamber; aperture an irregular, elongated opening at the base of the umbilical margin of the last formed chamber.

Occurrence.—This species is a distinctive and quite common form at a number of outcrop localities in the basal Yegua, and also appears in beds presumably near the top of the Yegua in the fossiliferous outcrop on the Sabine.

Cotypes.—(Cushman Coll. No. 12208) North of Nixon, Gonzales Co., Texas.

Genus LAMARCKINA Berthelin, 1881

LAMARCKINA MARYLANDICA Cushman, var. YEGUAENSIS Cushman

Lamarckina marylandica, var. *yeguaensis* CUSHMAN, Contrib. Cushman Lab. Foram Res., vol. 2, pt. 1, p. 10, 1926; vol. 2, pt. 2, pl. 4, figs. 1 *a-c,* 1926.

Occurrence.—This variety is very abundant in some phases of the basal Yegua found at outcrop localities. Unfortunately its geographical distribution seems to be very small.

[11] Rep. Voy. *Challenger,* Zoology, vol. 9, pl. 74, figs. 24-26, 1884.

Genus GYROIDINA d'Orbigny, 1826

GYROIDINA SOLDANII d'Orbigny, var. OCTOCAMERATA Cushman and G. D. Hanna

Gyroidina soldanii d'ORBIGNY, var. *octocamerata* CUSHMAN and G. D. HANNA, Proc. Calif. Acad. Sci., 4th ser., vol. 16, no. 8, p. 223, pl. 14, figs. 16-18, 1927.

Occurrence.—This variety is very common in the Yegua, both in the outcrop sections and in the subsurface samples from the Domes. It is found in the Cook Mt. beds of Texas and is reported from the Guayabal formation of Mexico.

GYROIDINA GUAYABALENSIS Cole

Plate 42, figs. 1 *a-c*

Gyroidina guayabalensis COLE, Bull. Amer. Pal., vol. 14, no. 51, p. 28, pl. 2, figs. 25-27, 1927.

Occurrence.—A few specimens of a form which we are referring to this species occur occasionally in Marine Yegua beds.

Subfamily ROTALIINAE

Genus EPONIDES Montfort, 1808

EPONIDES GUAYABALENSIS Cole, var. YEGUAENSIS, n. var.

Plate 42, figs. 2 *a-c*

Description.—Test moderately large, broad, somewhat compressed, usually unequally biconvex, ventral side strongly convex, dorsal side very gently arched; periphery sub-acute; about three whorls visible above, only the chambers of the last formed coil shown below, 9 or 10 chambers in the last volution; sutures distinct, limbate, slightly angular on the dorsal side, radiate on the ventral side and broadening near the umbilicus which is surrounded by a ring of clear shell material; walls finely perforate; aperture a narrow opening extending from the umbilical area to within a short distance of the periphery.

This form is most probably derived from the common Lower Claiborne species, *Eponides guayabalensis* Cole, and was evidently included under that species by Cushman and Thomas[12]. Although rare specimens are occasionally found in Lower Claiborne beds, the variety could not be considered at all characteristic of that formation, while in the Yegua it is one of the most wide spread and abundant forms. The typical Lower Claiborne species is trochoid, highly convex above, flat to slightly convex below. It is narrower and the

[12] Journ. Pal., vol. 3, no. 2, p. 180, 1929.

chambers of the last formed whorl are smaller and more numerous than on the typical Yegua form. The periphery is usually rounded while in the Yegua variety it is sub-acute.

The fact that the differences mentioned above are apparently constant, and that the variety *yeguaensis* is one of the most characteristic forms in the Yegua formation, seems to us sufficient reason for describing it here as a new and distinct varietal form.

Occurrence.—Yegua formation of Texas, occasional specimens also found in the Cook Mt.

Cotypes.—(Cushman Coll. No. 12209) John Deering well, Bissonett No. 2, 4,015 ft., Humble, Harris Co., Texas.

Genus EPISTOMINA Terquem, 1883

EPISTOMINA EOCENICA Cushman and M. A. Hanna

Epistomina eocenica CUSHMAN and M. A. HANNA, Trans. San Diego Soc. Nat. Hist., vol. 5, no. 4, p. 53, pl. 5, figs. 4-5, 1927.

Occurrence.—Rare specimens of this species which was described from the Eocene of San Diego by Cushman and M. A. Hanna are found in the Upper Claiborne beds of the Gulf Coastal area.

Genus SIPHONINA Reuss, 1849

SIPHONINA TENUICARINATA Cushman

Siphonina tenuicarinata CUSHMAN, Proc. U. S. Nat. Mus., vol. 72, art. 20, p. 6, pl. 4, fig. 1, 1927.

Occurrence.—This Mexican species is also very common in the Upper Claiborne beds of Texas.

Family CASSIDULINIDAE

Subfamily CERATOBULIMININAE

Genus CERATOBULIMINA Toula, 1920

CERATOBULIMINA EXIMIA (Rzehak), var.

Plate 42, figs. 3 *a*, *b*

Pulvinulina eximia RZEHAK, Ann. k. k. Nat. Hofmuseum, vol. 3, pt. 3, p. 263, pl. 11, figs. *a-c*, 1888.

Ceratobulimina eximia TOULA, Jahrb. Geol. Reichsanst, vol. 64, p. 665, 1920.

Discussion.—This species which shares with *Eponides guayabalensis* the dominant place in the Lower Claiborne fauna is a rare species in the Upper Claiborne beds. It is also usually much smaller, more elongate in outline, and sometimes rather highly ornamented

with flattened bands of shell material which outline the suture lines, when present in the Yegua beds.

Occurrence.—Abundant in the Cook Mt. Lower Claiborne beds, rare in the Upper Yegua beds, slightly more common in the basal Yegua at some outcrop locations.

Plesiotypes.—(Cushman Coll. No. 12218) North of Nixon in Gonzales Co., basal Yegua.

Family GLOBIGERINIDAE

Subfamily GLOBIGERININAE

Genus GLOBIGERINA d'Orbigny, 1826

GLOBIGERINA INFLATA d'Orbigny

Globigerina inflata D'ORBIGNY, Hist. Nat. Isles Canaries, vol. 2, pt. 2, "Foraminifères", p. 134, pl. 2, figs. 7-9, 1839.

Occurrence.—This is a common species in both Upper and Lower Claiborne beds of Texas.

GLOBIGERINA YEGUAENSIS, n. sp.

Plate 43, figs. 1 *a*, *b*

Description.—Test large, globose, somewhat flattened along the dorso-ventral line, consisting of about 9 chambers arranged rather irregularly in two and a half whorls, spire compressed, last three chambers forming about two-thirds of the surface of the test, sutures much depressed, surface finely perforate, aperture an arched opening into the umbilicus.

Occurrence.—Subsurface Yegua of the Texas Gulf Coast.

Holotype.—(Cushman Coll. No. 12210) Rio Bravo Oil Co., Deussen B 1, South Liberty, Liberty Co., Texas.

Family GLOBOROTALIIDAE

Genus GLOBOROTALIA Cushman, 1927

GLOBOROTALIA CRASSATA (Cushman)

Pulvinulina crassata CUSHMAN, Bull. Amer. Assoc. Pet. Geol., vol. 9, no. 2, p. 300-301, pl. 7, figs. 4, 1925.

Globorotalia crassata COLE, Bull. Amer. Pal., vol. 14, no. 51, p. 34, pl. 1, figs. 7, 8, 1927.

Occurrence.—This form is also common throughout the Claiborne in Texas.

Family ANOMALINIDAE

Subfamily ANOMALININAE

Genus ANOMALINA d'Orbigny, 1826

ANOMALINA COSTIANA, n. sp.

Plate 44, figs. 7 *a-c*

Description.—Test small, compressed, involute, almost equally biconvex, peripheral margin angled, chambers numerous, 9 or 10 in the last formed coil, comparatively long and narrow; sutures on the ventral side limbate, slightly raised, extending from the margin to the umbilicus which is covered by a low boss of clear shell material; on the dorsal side, also limbate, extending from the periphery to within a short distance from the inner end of the chamber, where the limbate covering broadens rapidly, is more elevated and ends abruptly. These prominent sutural endings show through the central opening from the earlier whorls and give the center of the test a beaded appearance, which is accentuated by the narrow, smooth band of unornamented material which separates it from the remainder of the test, decorated with the suture lines described above. Mouth opening a narrow slit at the periphery on the last formed chamber.

Occurrence.—This form is probably one of the most characteristic of all the Yegua forms since it is found in many of the very sparsely fossiliferous Middle Yegua horizons as well as in the basal outcropping beds and subsurface sections in the Domal area near the Coast. It is apparently confined to the Yegua formation.

Cotypes.—(Cushman Coll. No. 12211) about one-half mile north of Cost on the Monthalia Road, Gonzales Co., Texas.

ANOMALINA UMBONATA Cushman

Anomalina umbonata CUSHMAN, Bull. Amer. Assoc. Pet. Geol., vol. 9, p. 300, pl. 7, figs. 5, 6, 1925.

Occurrence.—In some of the Yegua samples studied from South Texas coastal Domes a form which we are referring to this species is rather common.

Subfamily CIBICIDINAE

Genus CIBICIDES Montfort, 1808

CIBICIDES DEUSSENI, n. sp.

Plate 44, figs. 2 *a-c*

Description.—Test planoconvex, dorsal side flat to slightly concave,

ventral side moderately convex, frequently with umbo covered with a small boss of clear shell material; peripheral margin thin, slightly lobulate; chambers narrow, earlier coils almost completely covered by the one last formed, in which there are eight or nine chambers; sutures limbate, very strongly curved, almost V-shaped on the ventral face; walls finely perforate; aperture an arched opening at the periphery with a narrow slit extending back along the suture line to the middle of the test. This form is very close in its general appearance to *Anomalina mantaensis*,[13] Galloway and Morrey, but the chambers are more numerous, and the mouth opening differs also as noted by the description.

Occurrence.—This is a common species in some phases of the Yegua found in subsurface samples from the Gulf Coast.

Cotypes.—(Cushman Coll. No. 12212) Rio Bravo Oil Co., Deussen B 1, 4,010 ft., South Liberty Dome, Liberty Co., Texas.

[13] Bull. Amer. Pal., vol. 15, no. 55, pp. 28, 29, pl. 4, fig. 5, 1929.

THE OCCURRENCE OF KYPHOPYXA IN CALIFORNIA

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The foraminiferal genus *Kyphopyxa* was erected by Dr. J. A. Cushman for the species previously described by Mrs. Carsey as *Frondicularia christneri* from the Taylor Marl and Austin Chalk. Her paper "Foraminifera of the Cretaceous of Central Texas", was published in the Univ. Texas Bull. 2612, 1926, p. 41, pl. 6, fig. 7.

The new genus was described and figured by Dr. Cushman in his Contrib. Cushman Lab. Foram. Res., vol. 5, pt. 1, pl. 1, figs. 1-7, March, 1929. The species is described as having a limited range, developing in the upper Cretaceous and becoming extinct by Middle Taylor time (in Texas). The form has been noted from Texas, Arkansas and Florida and is said to have been widely distributed and very often abundant at the time of its greatest development. It is most common in beds of Lower Taylor age.

Well developed upper Cretaceous Foraminifera in California were known to the author by the latter part of 1928 but not until May, 1929, was the genus *Kyphopyxa* noted. This was soon after the new genus had been described and the identity was recognized at once. The form appears to be nearly the same as the Texas species but with some workers it might be considered as new.

The material from which the California species was taken was collected by Dr. G. D. Hanna and J. H. Show in Kings County, California, sec. 36, T. 23 S., R. 17 E., at the south end of Reef Ridge, from near the top of the Upper Cretaceous outcrop. The formation is a buff (gray when fresh), clay shale.

The species was again found in association with a similar fauna in gray clay shales 4.8 miles up Salsipuedes Creek from its junction with El Jaro Creek about 10 miles south of Lompoc, Santa Barbara County, California.

Kyphopyxa as noted in California is a well developed species but in no instance has it been found in abundance.

A METHOD FOR THE SEPARATION OF HEAVY MINERALS OF FINE SOIL

IRVIN C. BROWN
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In making a mineralogical examination of soils, the writer has found it desirable to obtain a clean quantitative heavy mineral separation to meet the following conditions:

1. Most soils contain minerals in the finer grades that are not represented in the larger size grades.
2. The heavy minerals in the silt grades are so subordinate to the quartz that their determination, if unseparated, is a slow process.
3. A clean concentrate permits a rapid comparative count in determining the quantitative abundance of each species. Such knowledge is of considerable value.

In attempting to separate the heavy minerals with bromoform by the usual methods, the concentrate was contaminated with quartz in the coarse silt grade, and no concentrate at all was obtained from the fine silt or finer grades. In order to make a heavy mineral separation which would aid in a rapid determination and give quantitative results it was necessary to devise a special technique.

PREPARATION OF THE SAMPLE

Samples containing the finer particles are separated into three size grades by repeated subsidence in distilled water.[1] The grades used consist of the material larger than 1/32 millimeter, 1/32-1/64 millimeter, and 1/64-1/128 millimeter. This material is checked by using a microscope micrometer to be certain that the sizes of each grade are within the limits prescribed.

[1] For full details of the method see University of Iowa Studies in Natural History, vol. XI, no. 11, p. 59.

Procedure for the Quantitative Heavy Mineral Separation in Fine Grades

Centrifuge tubes of fifteen cubic centimeters capacity are filled half full with freshly distilled bromoform and into these are poured one to two gram weighed portions. The samples were dried previously at one hundred fifty degrees centigrade. The drying must be thorough, and all absorbed matter must be removed, for the smallest trace of water tends to cause the particles of the silt grades to stick together, and no separation is accomplished.

Few or none of the heavy minerals settle to the bottom of the tubes after standing for ten minutes. The samples are then centrifuged for five minutes at twenty-five hundred revolutions per minute. The length of the radius arm is ten inches. Most of the heavy minerals settle to the bottom during this first period of the centrifuging, but as an added precaution, and to prevent any of them from being held in the firmly compacted mass of light minerals, the tubes are shaken gently to again distribute these minerals loosely at the upper portion of the liquid. This is repeated three times to insure complete separation. The speed of the centrifuge as given is sufficient for even the fine silt grades, but the time of centrifuging may be shortened if a higher speed is used. A speed as low as fifteen hundred revolutions per minute gives satisfactory results with the coarse silt grades. The heavy minerals may be removed from the bottom of the tubes with a pipette fitted with a rubber bulb. A small amount of the light minerals will adhere to the pipette as it passes through the top of the bromoform, but these may be washed off quickly before the pipette is projected to the bottom of the tube and the heavy minerals picked up. This method is satisfactory for qualitative work, but it is difficult to make a complete removal of all the grains in the bottom of the tube. Also, the pipette may be used to remove the light minerals from the upper part of the bromoform but it is difficult to make a complete removal of all grains adhering to the sides of the tube.

For precise quantitative separation of the heavy minerals, the centrifuge tubes are modified by sealing to the bottom a small glass receptacle two centimeters long and with a bore of four millimeters for the reception of the heavy minerals. The above dimensions were found sufficient for one to two gram samples, but should be larger if a larger sample is to be used or if the heavy minerals are more abundant than ten to fifteen percent or if the method is applied to the coarser size grains. In this more exact method the sample is

weighed to one hundredth of a gram. To recover the heavy mineral separate, the small receptacles are filed at the point of attachment to the tubes and broken off. If the open end of the centrifuge tube is kept tightly stoppered during this operation, the loss of bromoform is negligible. The receptacle containing the heavy minerals is then placed in an oven to evaporate the small amount of bromoform. The light minerals and the larger amount of bromoform are separated by filtering through a coarse filter paper, a commonly used method. The heavy mineral separate is weighed on a balance accurate to one tenth of a milligram.

The following results were obtained from duplicate samples of three fine grades:

Grade in millimeters	Percent of heavy minerals	
	Number 1	Number 2
1/16-1/32	2.24	2.28
1/32-1/64	1.89	1.93
1/64-1/128	1.81	1.72

These results show the quantitative accuracy of the method when as small a sample as one gram is used. In the case of soils, the amount of material remaining in the grades used is often small, and considerable precision is necessary.

Both the heavy and light mineral separates have been checked with the petrographic microscope to determine the completeness of separation. Only an occasional grain of quartz, or other low specific gravity mineral was found with the heavy minerals, and in many cases the field of view showed no light minerals. The light mineral separates were equally free of heavy minerals.

SUMMARY

In carrying out the above method it is very important to have all material and apparatus free from the smallest amount of moisture, and the samples must be centrifuged to obtain a quantitative separation of the heavy minerals. The method is rapid, and only a small amount of bromoform is lost during the process.

RESEARCHES IN PALEONTOLOGY

Charles Ryniker, paleontologist for the Gypsy Oil Company, in collaboration with J. J. Galloway, is working on the micro-fauna of the Atoka formation.

C. C. Church, paleontologist for Associated Oil Company, has been working for the past year on the Miocene foraminifera of Astoria, Oregon, and the foraminifera of the Monterey shale of California.

J. A. Cushman and C. C. Church have prepared a paper entitled *Some Upper Cretaceous Foraminifera from near Coalinga, California,* which has just been published by the California Academy of Sciences.

Harold J. Cooke at the Colorado Museum of Natural History during the past summer has been pushing actively his researches on Pleistocene man. He has directed one field party working in the caves of northeastern New Mexico and the adjoining areas of Oklahoma and Colorado, and has been an active member of another party excavating gravel deposits in the Panhandle region of west Texas, where he has discovered a wide range of fossil mammals. Among the papers which Dr. Cooke has published or has in preparation are: *New Pliocene Rhinoceros; New Evidence of Folsom Man Associated with Mammoth Remains in Colorado; Studies on the Deciduous and Permanent Dentition of Oligocene Entelodonts.*

O. P. Hay and H. J. Cooke have in press a paper entitled *Studies of the Pleistocene Mammals of Frederick, Oklahoma, Colorado, Texas, and Folsom, New Mexico, found Associated with Evidence of Man.*

J. Brookes Knight, Peabody Museum, Yale, is engaged in a detailed study of the paleontology and stratigraphy of some outcrops in St. Louis and St. Louis County, Missouri. Though some Cherokee forms are represented in his faunas, the bulk of his collection is from the Henrietta formation. The material is remarkable for the numbers and excellence of preservation of the small gastropods.

John A. Sandidge of the department of geology, Princeton, spent several months during the summer studying the micro-faunas from well cuttings in various parts of the North German Plain. His headquarters were in Oldenburg, Germany.

Dr. Katherine Van Winkle Palmer of Cornell University has been engaged for some time on a monograph of the gastropods of the St. Maurice and Claiborne Eocene. The completed work is to be published as Bulletin 32 of the Bulletin of American Paleontology.

W. S. Adkins of the Bureau of Economic Geology, University of Texas, is engaged in a paleontologic and stratigraphic study of the Fredericksburg group of the Lower Cretaceous of Texas, and plans to publish a series of papers on Fredericksburg fossils. His first paper of the series will be on the genus *Oxytropidoceras.*

G. Dallas Hanna of the California Academy of Sciences is continuing energetically his excellent work on diatoms. He has ready for publication the following papers: *The Diatoms of Shark Tooth Hill, Kern County, California; Fossil Diatoms Dredged in Bering Sea;* and the *Geology of Shark Tooth Hill, Kern County, California.* He has in preparation also several monographs, as follows: *Genera of Diatoms; Atlas of Monterey Miocene Diatoms;* and *A Check List of West American Diatoms.*

E. B. Branson of the University of Missouri has in press a monograph on the *Paleontology and Stratigraphy of the Lower Mississippian of Missouri.* The monograph will be issued the first of the year and will contain about 500 pages and 60 or 70 plates illustrating Mississippian fossils.

T. Wayland Vaughan of Scripps Institute of Oceanography, notwithstanding his long trips during the past year to the Dutch East Indies and other parts of the world in search of new and larger foraminifera, finds time to publish a long list of researches. Among these the following have come to the Secretary's attention:

Results of Recent Investigations of American Tertiary Larger Foraminifera. Third Pan-Pacific Science Congress, 1926, Tokyo, Proceedings, pp. 1850-1857, 1929.

Descriptions of New Species of Foraminifera of the Genus *Discocyclina* from the Eocene of Mexico. United States Nat. Musuem, Proceedings, no. 2800, vol. 76, art. 3, pp. 1-18, pls. 1-7, 1929.

Studies of Orbitoidal Foraminifera: the Subgenus *Polylepidina* of *Lepidocyclina* and *Orbitocyclina*, a New Genus. Nat. Acad. Sci., Proceedings, vol. 15, no. 3, pp. 288-295, March, 1929.

A. S. Warthin, Jr., professor of geology at Vassar College, is now completing a study of the micro-faunas of the Wetumka, Wewoka, and Holdenville formations of Oklahoma.

M. G. Mehl and E. B. Branson have completed a paper on Triassic amphibians of the Rocky Mountain Region which will be published soon.

Richard D. Norton, geologist for The Texas Company at Shreveport, Louisiana, has prepared for publication this winter a paper entitled *Ecologic Relations of Some Smaller Foraminifera.*

Miss Betty Kellett is now engaged in micro-paleontologic work in the laboratory of the Amerada Petroleum Corporation at Tulsa, Oklahoma.

R. S. Bassler and Miss Betty Kellett are preparing a bibliography of the fossil ostracoda.

J. A. Cushman and Miss Betty Kellett, working in the Cushman Laboratory for Foraminiferal Research, have prepared a paper recently published by the Smithsonian Institution: *Recent Foraminifera from the West Coast of South America.*

Clinton R. Stauffer, professor of paleontology at the University of Minnesota, has a paper ready for publication on some conodonts from the Decorah shale of Minnesota.

Lyman C. Reed and Oscar M. Longnecker, Jr., have completed a report on the geology of Hemphill County, Texas, which will be published by the University of California. These geologists discovered a very large and interesting lower Pliocene mammalian fauna in Hemphill County which will be described by Dr. W. D. Matthew and associates of the University of California.

Charles Laurence Baker, geologist for the Southern Pacific Railroad, has completed a study of many years duration on the Permian Red Beds and Saline Residues and has published two articles in University of Texas Bulletin No. 2901: *Mode of Deposition of Permian Basin Saline Residues* and *Depositional History of the Red Beds and Saline Residues of the Texas Permian.*

W. S. Adkins of the Bureau of Economic Geology, University of Texas, has published an article, *Some Upper Cretaceous Taylor Ammonites from Texas,* in University of Texas Bulletin No. 2901.

W. D. Matthew has completed a revision of the mammalian faunas of the high plains of Texas.

Bruce H. Harlton, paleontologist for the Amerada Petroleum Corporation at Tulsa, is having published an article in the January number of University of Texas Bulletin on *Pennsylvanian Ostracoda from Menard County, Texas.*

Charles Laurence Baker, geologist for the Southern Pacific Railroad at Houston, is preparing a volume on the geology of Mexico. Mr. Baker will appreciate receiving from members of the Society any data on Mexican geology.

Margaret Fuller Boos had made a special study of the geology and natural history of Rocky Mountain National Park, Colorado. Last summer she was appointed Naturalist by the National Park board. During the past two summer seasons she has written pamphlets and delivered lectures on the natural history of the Park.

L. W. Stephenson of the United States Geological Survey is making substantial progress in the preparation of a monograph on the larger fossils of the Navarro formation of Texas. This is a co-operative project with the Bureau of Economic Geology of the University of Texas, under whose auspices the volume will be published.

Robert Roth, paleontologist for the Indian Territory Illuminating Oil Company, has completed a study of the ostracods of the Haragan marl of the Devonian of Oklahoma and published in this number of the Journal. The work has taken about two years and will be a much needed addition to knowledge of the paleontology of Oklahoma.

G. Marshall Kay, working in the department of geology at Columbia University, is engaged in a study of the paleontology and stratigraphy of the Black River and Lower Trenton formations in Iowa, Missouri, Ontario, and New York. In his researches he has specialized on the ostracods.

Albert W. Giles of the geological department of the University of Arkansas is preparing for publication as a bulletin of the Arkansas Geological Survey a paper on St. Peter and older Ordovician sandstones of northern Arkansas. He has also a paper nearly ready for publication on *Some Textural Features of St. Peter Sandstone.*

G. E. Condra and R. C. Moore of the state geological surveys of Nebraska and Kansas are preparing jointly a monograph on the

bryozoa of the Pennsylvanian formations of the Mid-Continent. They have already identified more than 294 species from a very large assemblage of material collected from Missouri, Nebraska, Kansas, Oklahoma, and Texas.

Miss Julia A. Gardner of the United States Geological Survey sailed for England the middle of November. She plans to spend two months in studying Tertiary fossils in the British Museum and then to visit several museums on the Continent.

C. G. Croneis, at Walker Museum, University of Chicago, is engaged in a study of the ostracods of the Chester formation of Illinois and hopes to have his paper ready for publication by the Illinois Geological Survey in the spring.

F. B. PLUMMER, *Secretary.*

FALL FIELD MEETING OF THE SOCIETY

The third annual fall field meeting of the Society of Economic Paleontologists and Mineralogists was held at the University of Texas, Austin, Texas, November 16, 17 and 18. The weather man was kind, and clear warm southern skies greeted the one hundred and more paleontologists who assembled in Austin from Mexico, Mississippi, Louisiana, Oklahoma, Kansas, Nebraska, and Texas.

The meeting opened Friday evening when the visiting members were guests of the Southwestern Geological Society and listened to a beautifully illustrated lecture by W. M. Winton of Texas Christian University on *Recent Developments in Paleontology.*

Saturday morning R. H. Cuyler and F. M. Bullard of the University faculty conducted the visitors across the geologic section around Austin. There was opportunity to collect fossils and lithologic samples from formations ranging in age from the massive Edwards limestone at the bottom to the Navarro clays at the top. Exposures showing formation contacts were observed, and talks on the local geology were delivered by Mr. Cuyler.

Saturday afternoon most of the paleontologists preferred taking notes on the football game between Texas and Texas Christian University to observing geologic sections. Some, however, journeyed to Onion Creek south of Austin and collected bags of clay and photographed exposures around the famous Pilot Knob basaltic plug.

Saturday evening the annual banquet was held at the University Commons. One hundred fourteen geologists sat down to tables decorated with roses and bright with candles and enjoyed the pleasant feeling that comes with good comradeship at a good meal. Following the dinner Prof. F. W. Simonds introduced the speakers for the following program of addresses:

Greetings	J. A. Udden
Some Fossils I Have Met	H. Y. Benedict
The Society of Economic Paleontologists and Mineralogists	M. A. Hanna

Carboniferous Reverberations from the Northern Mid-Continent	G. E. Condra
Paleontologic Repercussions from the Same	R. C. Moore
Field Trip to the Rio Grande Valley	W. S. Adkins
Field Trip to the Glen Rose Section	F. L. Whitney
Field Trip to Llano and San Saba	E. H. Sellards

It was a rare opportunity to hear speakers like Udden, Benedict, Hanna, Condra, and Moore all in one evening. The silver-tongued orator from Nebraska justified fully his reputation as a vigorous speaker and inspired all his hearers by his call for more co-operation in the solution of stratigraphic problems in the Mid-continent. The well-known speaker from Kansas followed with a series of witticisms that repercussed, and reverberated across the tables in peals of laughter; then grew serious and reviewed the results of recent geological work in Pennsylvanian stratigraphy of the northern Mid-continent in his most able manner.

Sunday morning there was the choice of three excursions. One party left for the Rio Grande Valley in the vicinity of Del Rio and Eagle Pass, under the direction of W. S. Adkins to see the Mid-Cretaceous section of south Texas and northern Mexico. A second group was lead by E. H. Sellards to Fredericksburg, Llano, and San Saba, Texas, to observe the outcrops across the Llano uplift and to collect from the Cambrian, the Mississippian, and Lower Pennsylvanian formations around San Saba and Bend. A third trip was conducted by F. L. Whitney across the Glen Rose and Travis Peak section, in the Pedernales River valley west of Austin to study the Lower Cretaceous formations. About fifty geologists followed Dr. Sellards to Llano and San Saba and collected everything from specimens of fresh water pearls to igneous boulders. Thirty-five took the long road to Del Rio, listened to lectures on Mexican art and Cretaceous fossils by Adkins and afterwards enjoyed meals of venison, quail, wild turkey and sparkling liquids across the Border in the land of frijoles and large ammonites. The rest of the paleontologists followed Prof. Whitney over the beautiful valleys and up the cliffs of the Lower Cretaceous limestones and collected *Orbitolina, Trigonia,* and *Anomia* until they were tired.

Altogether the third field meeting was a large and enjoyable occasion, noteworthy for the excellence and variety of its program, its large attendance, length and completeness of its field excursions, and fullness of its good fellowship.

F. B. PLUMMER, *Secretary.*

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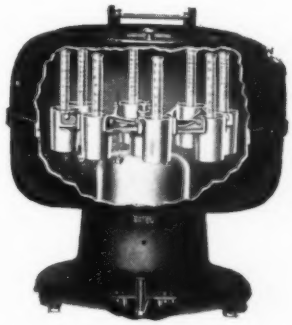

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